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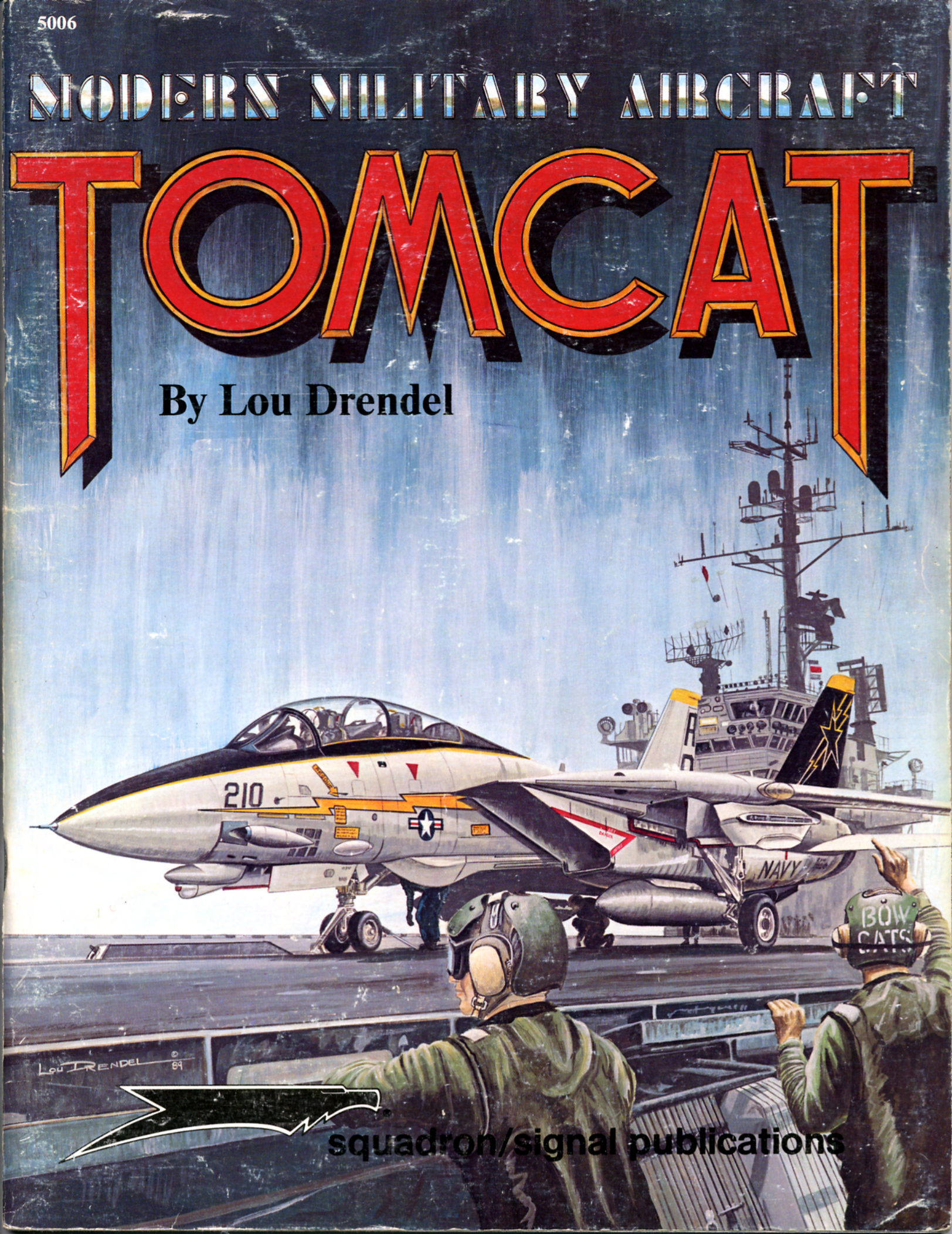
MODERN MILITARY AIRCRAFT

TOMCAT

By Lou Drendel



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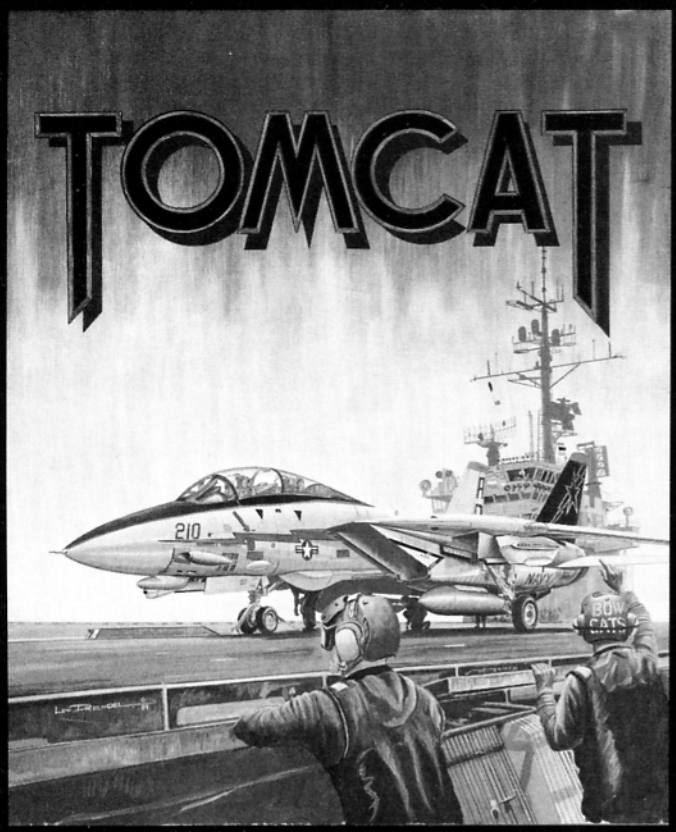

An F-14A Tomcat of VF-33 moves into position on the catapult of USS AMERICA.

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High humidity and high speed combine to create a water vapor outline of the shock wave surrounding the fuselage of this F-14A Tomcat as it nears the sound barrier. (U.S. Navy)

INTRODUCTION

When I wrote "F-14 In Action" during 1977, the Tomcat was a relatively new aircraft. It had made its first operational deployments just two years previously and there were only ten squadrons in active service. A lot has happened since 1977, but Grumman's big swing-wing fighter is still the hottest thing in the fleet. It was the aircraft flown by Maverick and Goose in "TOP GUN" and, while all Tomcat pilots won't end up with Kelly McGillis, you can bet that they believe the only reason is that there is a limited supply of Kelly McGillises. Tomcat pilots are the elite of the carrier air wings, masters of the air-to-air arena, the tip of the foreign policy sword and are filled with a self-confidence borne of the certain knowledge that they are flying the best fighter-interceptor the Navy has ever put aboard ship.

Victories against terrorism are few and far between, but the most celebrated victories in recent years have been won by Tomcats and Tomcat pilots. These include four kills against the Libyan Arab Air Force and the capture of the hijackers of the ACHILLE LAURO.

The Tomcat was born almost twenty years ago, yet with new engines and a remanufacturing program the F-14D will remain in front-line service well into the next century. The fact that new technology can be integrated into the basic airframe of the Tomcat is an impressive tribute to the sound design of the F-14. In this book you will read the experiences of four of the Tomcat's test pilots. These are men who are uniquely qualified to discuss the design of the airplane and how it has been kept up to date with new avionics, engines and improved tactics. From this vantage point, it would be easy to call the F-14 "The Timeless Tomcat."

Grumman Aircraft Corporation Chief Test Pilot Bob Smyth briefs Grumman and Navy officials on the first flight of the F-14 prototype on 21 December 1970. The flight took place at Grumman's Calverton Air Test Facility. (Grumman)

During March of 1972, the number eleven F-14 prototype was hoisted aboard USS INDEPENDENCE (CV-62) for deck compatibility testing. The test program included towing the aircraft around the deck, but did not include flight operations. (U.S. Navy)

Grumman ground crews check out a natural metal F-14A (BuNo 158990) on the ramp at Grumman's Bethpage facility during 1973. The aircraft has not yet been painted with its Gloss Gull Gray and Gloss White paint scheme. (Lionel Paul via D.F. Brown)

This F-14 is fresh from the paint shop and ready for delivery to the Navy. The aircraft carries contractor number 48 on the fin and its BuNo (158987) below the tail. (Lionel Paul via D.F. Brown)

TOMCAT ALMANAC

OCTOBER - 1967:

Although the prime contractor on the F-111B, the Navy version of the TFX, Grumman proposes to the Navy that they build an all-new fleet interceptor, utilizing the weapons system of the F-111, while not having the weight penalties of the F-111B.

MAY - 1968:

The Navy version of the F-111 program is cancelled after a series of programs designed to improve the overweight and over-budget aircraft failed to produce any lasting solution.

JULY - 1968:

The Navy issues Requests For Proposal (RFP) for entries into the Navy VFX (Navy Fighter Experimental) program. Five companies respond: Grumman, North American, McDonnell-Douglas, LTV and General Dynamics. The Grumman proposal is the front-runner, having benefited from a strong anti-TFX lobby in the Pentagon.

JANUARY - 1969:

Grumman Aircraft Engineering Corp. is selected to do the engineering design phase of the VFX under the designation F-14A. The Navy announced plans to buy 463 F-14As and F-14Bs, plus six prototypes at an estimated unit cost of $7.3 million. The full-scale mockup of the F-14 is shown at the Grumman plant. It features variable geometry wings, an internal 20MM cannon and provisions for carrying Sparrow, Sidewinder, and Phoenix missiles. The F-14 will also be able to carry a variety of conventional air-to-ground ordnance. At the rollout, Grumman announced plans for follow-on versions of the F-14 which will utilize new engines and updated avionics. The B and C versions are expected to be operational by 1974 and 1975, respectively.

Inevitable comparisons are made with the deceased F-111B. The F-14 will use more titanium than any aircraft other than the SR-71, resulting in weight savings that amount to a 16,000 pound gross takeoff weight and 8,000 pound landing weight advantage over the F-111B. It will have 26% greater power plant efficiency at the loiter design point. Wing sweep rates are twice that of the F-111 and the movable portion of the wings are shorter, resulting in a lighter, stronger wing structure. The F-14 features tandem seating of the pilot and NFO under a single-piece bubble canopy which affords better all-around vision for the crew. It also is the first American aircraft designed with two vertical tail surfaces.

MAY - 1970:

The Navy announces that the Hughes Aircraft Co. AWG-9 fire control system will enhance performance of the Phoenix missiles beyond what was anticipated from the General Dynamics F-111B fleet defense interceptor, the aircraft that the system was originally developed for. Among the improvements were a longer detection range for both the Phoenix and Sparrow missiles carried by the F-14, and air-to-ground weapons delivery with a 10-mil accuracy. Other improvements included a savings in system weight and volume of 33 percent. The Phoenix missile system had been under development since 1962 and the added costs of adapting it to the F-14 pushed its overall development costs to over a half a billion dollars. It was expected to give the Navy missile system superiority over any potential adversary for at least five years after its introduction.

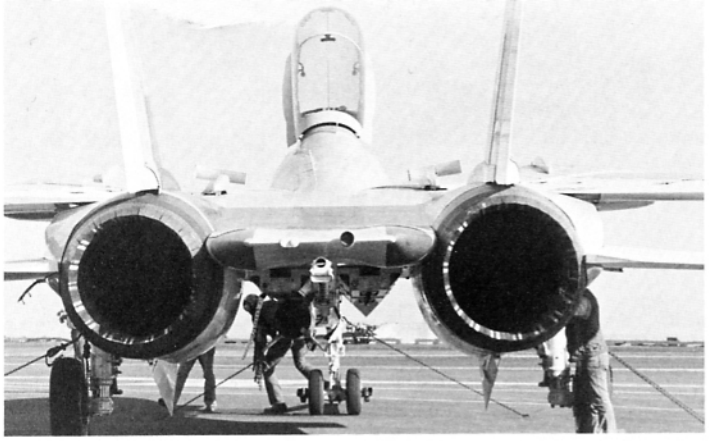
21 DECEMBER 1970:

The F-14, with Grumman Chief Test Pilot Bob Smyth in the front seat and project test pilot Bill Miller in the rear seat, made a routine first flight.

JANUARY - 1971:

A series of failures in both the primary and redundant flight control systems lead to the crash of the number one prototype on its second flight. Pilots Smyth and Miller eject safely. The loss of this prototype, instrumented for the high speed test phase, was expected to delay the test program by four to six weeks.

The USAF Aerospace Defense Command (ADC) announced that it might order a limited number of F-14s if testing shows that the F-14 meets its design specifications. The Air Force stated that they were not sure that the F-15 would have the range or loiter time necessary to perform the air defense mission. The F-14 was expected to be operational before the F-15.



Deck crews check the tie downs on this F-14A aboard USS FORRESTAL (CVA-59) during the Tomcat's carrier suitability trials held in December of 1973. The round hole in the center of the boat tail fairing is the fuel dump pipe. (U.S. Navy)

24 MAY 1971:

The four to six week delay in testing was actually four to six months. The number two prototype made its first flight on this date. High speed testing, which had been the job of the number one prototype, was not to resume until the 12th prototype came off the line.

SEPTEMBER - 1971:

High speed testing began in earnest when the new number one aircraft swept its wings completely for the first time.

OCTOBER - 1971:

The first aircraft to leave Grumman was the number four prototype, which was delivered to Point Mugu, California for installation of the AWG-9 fire control system. The fifth and sixth prototypes were also delivered to Point Mugu.

DECEMBER - 1971:

The Navy and Grumman announced an accelerated test program designed to get the F-14 into the fleet by 1973. The first Navy Preliminary Evaluation (NPE) was completed this month. It consisted of an evaluation of flying qualities, carrier capability, human factors and maintainability. Assignments of the prototype aircraft to various phases of the test program were announced:

No. 1X - the No. 12 aircraft was pulled from the line and redesignated aircraft 1X to replace the number one aircraft, which crashed on its second flight.

No. 2 - assigned to low-speed, high-lift and stall/spin testing. Variable geometry wings were locked at 20 degrees of sweep and the variable engine air inlet was locked full open.

No. 3 - devoted to structural buildup and demonstration. G limits of 6.5 for air-to-air and 7.5 for air-to-ground were announced.

No.4 - transferred to Pt. Mugu for installation of AWG-9 fire control system.

No.5 - transferred to Pt. Mugu for systems installation, test and compatibility work.

No.6 - first flight this month, was also transferred to Pt. Mugu for testing of missile separation and weapons system compatibility.

No.7 - scheduled to become the F-14B prototype, with TF-30 engine installed on one side and an F-401 engine on the other side.

No.8 - aerodynamic performance and demonstration work of a production configured aircraft.

No. 9 - assigned to Pt. Mugu for evaluation of the AWG-9 weapons system.

No. 10 - carrier suitability, assigned to NAS Patuxent River.

No. 11 - assigned to Pt. Mugu for compatibility testing of systems other than the weapons system.

No. 13 - Grumman proposed to use this aircraft for electromagnetic compatibility tests and electromagnetic and radio frequency interference functional compatibility work in its anechoic chamber at Calverton.

No.14 - maintenance and reliability demonstration aircraft.

No.15 through 19 - assigned to pilot training.

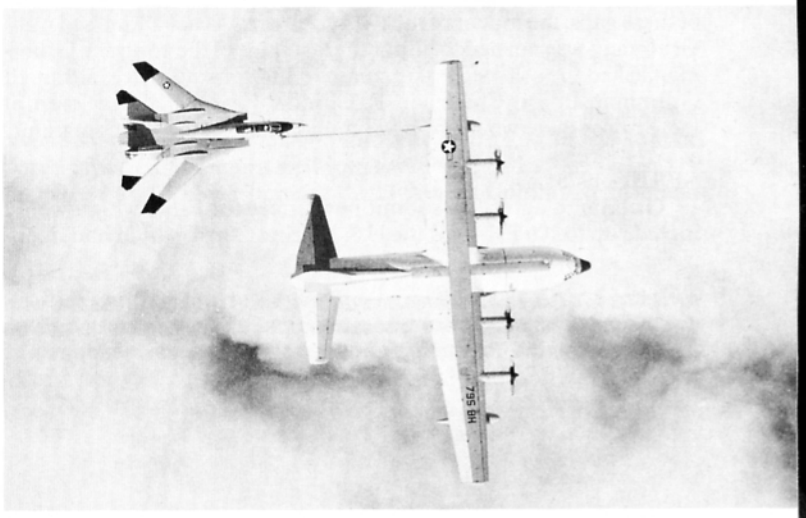
No. 20 - assigned to Pt. Mugu for climatic testing in the weather hangar.

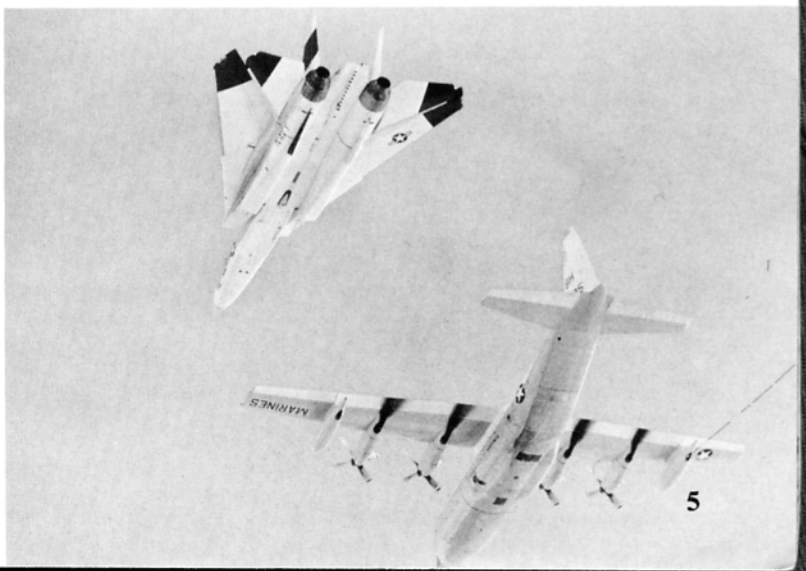
Using in-flight refueling and the new Automated Telemetry System (ATS) Grumman was able to dramatically accelerate the test program. The ATS converted raw flight test telemetry to hard engineering data in real time. One test flight lasted 12.5 hours and involved five in-flight refuelings.

JUNE - 1972:

Bob Miller was killed in the number 10 aircraft while practicing for a charity air show at Patuxent River. The aircraft crashed into Chesapeake Bay.

VF-124, the Pacific Coast Fleet Readiness Squadron, received its first F-14A.





(Above and Below) Aerial refueling tests were conducted using a Marine Corps KC-130F tanker and the number five F-14 prototype. The Tomcat test program benefited from the aircraft's ability to refuel, thereby extending test flights and condensing the time frame needed to complete the test program. (Grumman)

An F-14 prototype approaches the ramp of USS FORRESTAL for the Tomcat's first deck landing: a touch and go. The FORRESTAL was the host ship for carrier suitability testing held during December of 1973. (U.S. Navy)

OCTOBER - 1972:

The first two operational Tomcat squadrons, VF-1 and VF-2, were commissioned at NAS Miramar, California.

DECEMBER - 1972:

The future of the F-14 program was jeopardized when Grumman refused to accept a Navy order for forty-eight additional aircraft, claiming that they had lost one million dollars on each of the first eighty-six aircraft. The Navy was exercising its option under the terms of the 1969 total package contract, which Grumman termed "invalid and unenforceable." The total package concept was a throw back to the days of Secretary of Defense Robert S. McNamara. It had resulted in cost overruns, hardware which was not designed for the task at hand, and large technological gaps. Although the Nixon administration and Secretary of Defense Melvin Laird had closed many of these gaps, the matter of the F-14 contract was not addressed until Grumman was pushed to honor the last stage of the contract. Grumman asked for a 20 percent increase in the contract price, although Grumman Board Chairman E. Clinton Towl stated that even at these prices there would be a $23 million loss on the total program.

APRIL - 1973:

Grumman agreed to submit new prices for F-14s which would include up to 100 F-14s for the U.S. Marine Corps, which had intended to spend the money for 138 F-4Js. Unit costs varied from $10.2 million to $11.9 million per aircraft in fiscal 1974 dollars. The new prices would allow Grumman to ultimately realize a profit on the F-14, though not until 1975.

At the same time, a NASA report on the results of flight simulator profiling revealed that the F-14 would outfly anything the Soviets were likely to produce by 1976.

An NATC A-7 Corsair II shares the deck aboard USS FORRESTAL with the Tomcat during the F-14s first carrier operations. The Black lines on the fuselage of the Tomcat are photographic reference markings. (U.S. Navy)

JUNE - 1973:

Grumman and Honeywell announced that they were developing an anti-spin device for the F-14. This came as a result of tests that showed that at least 5 percent of the time when pro-spin controls were held, the aircraft would enter a flat spin. This would flame out the engines, resulting in a loss of flight controls and ultimately the aircraft.

The 22nd production F-14 appeared at the Paris Air Show. Flown by fleet pilots CDR Jim Taylor and LT Kurt Strauss, the Tomcat won praise from all in attendance with its demonstration of low speed maneuverability. A French newspaper called it the "pearl of the Paris Air Show."

JULY - 1973:

The plan to hold a competitive fly-off between the F-14D and the proposed naval version of the F-15 (designated the F-15N) was dealt a crippling blow by the House Armed Services Committee. Responding to a request by Deputy Defense Secretary William P. Clements, Jr., the committee eliminated $113.6 million in procurement funds singled out by Clements as partial payment for prototyping the two fighters.

AUGUST - 1973:

The U.S. announced plans to offer the F-14 and F-15 to Iran. The Shah of Iran asked for the two super fighters to counter MiG-25 over flights of his country.

The 58th Tomcat was in final assembly at Grumman's Long Island plant.

SEPTEMBER - 1973:

The Navy announced that it would pay a procurement cost of $13.9 million per aircraft for the F-14. This figure did not include $40 million in research and development funds included in the fiscal 1974 funding request by DOD. When this was included in the overall price, the per copy cost of the Tomcat rose to $14.7 million.

MARCH - 1974:

The Navy, feeling Congressional pressure to reduce the cost of the F-14 or face procurement of a possible 'cheaper' replacement, announced the F-14X, a version which would use either the Westinghouse WX-250 weapons control system, Westinghouse WX-200, or Hughes APG-64.

Also considered was the Optimod (optimum modification), with a choice of three computers for use with the AWG-9 system. Engine

modifications, a stripped version designated the F-14T and removal of the Phoenix missile system were estimated to save up to $500,000 per aircraft. The Navy hoped to head off a congressional mandate to acquire a navalized version of the USAF F-15, or a version of the lightweight fighter being developed for the Air Force.

MAY - 1974:

As a result of high combat losses of U.S. Navy developed combat aircraft flown by Israelis during the 1973 Middle East War, the Pentagon decided against development of the F-14X, opting instead for development of the VFX which it hoped to introduce to the fleet during 1981. In the meantime, the Navy requested funding for additional F-14As. Recognizing the problems with the TF-30 engine, the Navy made development of the F-401 engine a part of the $34 million VFX R&D package.

JULY - 1974:

A congressional flap was caused by the manner in which Grumman was handling advance payments from the Navy for the F-14. In order to compensate Grumman for an estimated loss of $220 million on the first 134 aircraft, the government had approved short term loans to Grumman at an interest rate of 6.7 percent. The prime rate at the time was 12 percent and the government was paying 7.6 percent for money it borrowed. Grumman, playing the money game like any good business, invested money not needed immediately in short-term government securities at interest rates of up to 10%. When the congress found out, they pressured the Navy into asking that the interest rate charged Grumman be raised to 9-1/8 percent.

Seventy-nine F-14s had been built and these had accumulated 14,000 flight hours.

AUGUST - 1974:

In order to further ease Grumman's financial woes, Secretary of Defense James Schlesinger requested Secretary of State Henry Kissinger's approval to negotiate accelerated payments from Iran for their F-14s.

SEPTEMBER - 1974:

The first operational deployment for the F-14 began as VF-1 and VF-2 put to sea aboard USS ENTERPRISE. It was the first deployment for a Grumman fighter since VF-111 returned with their F-11F Tigers aboard USS HANCOCK during March of 1961.

JULY - 1975:

F-14s were returned to flight status after being grounded after a fan blade separation in a TF-30 had damaged an aircraft in flight. This was the fifth such incident, with four of the five resulting in in-flight fires. Two of the five Tomcats were lost.

The Navy stated that the recently completed initial deployment of the F-14 was the most successful of a new sophisticated aircraft in Navy history. Operational availability figures for both VF-1 and VF-2 aboard USS ENTERPRISE during the evacuation of Saigon exceeded those for the F-4 squadrons aboard USS CORAL SEA during the same operation.

The Office of Management and Budget (OMB) reported that the F/A-18 was projected to cost as much as an F-14. In spite of this, DOD and the Navy declined to replace the F/A-18 with additional F-14s.

The Navy also announced that four squadrons of F-14s originally destined for Marine Corps use would be operated by the Navy. The Marines would eventually receive F/A-18s. In the meantime, the Navy transferred additional F-4s (that were scheduled for retirement) to the Marines.

SEPTEMBER - 1975:

In a unique public relations scheme, the Navy agreed to a drag race between the F-14 and a HOT ROD magazine-sponsored funny car. The race was held at the Naval Air Test Center and a local drag strip. The F-14 was attached to the TC-7 steam catapult and, with afterburners in zone five, launched at a gross weight of 53,000 pounds.

During the carrier suitability tests the F-14 blew the starboard main tire. The aircraft was towed to a parking spot by an aircraft tug with fire fighters standing by to cool off the hot wheels/brakes if required. (U.S. Navy)

It covered the 258 feet of catapult track in 1.76 seconds, achieving an end speed of 176.86 mph.

The funny car covered the same distance at the drag strip in 1.97 seconds with an end speed of 118.20. The results were published as a feature story in HOT ROD. There was no word on how many hot rodders applied for Navy flight training as a result of this unusual race.

DECEMBER - 1975:

Grumman announced that a 100 man advance team was in Iran to set up a training program for the Imperial Iranian Air Force (IIAF) which had eighty F-14s on order. Grumman expected to eventually have about 1,000 employees in Iran, with the support force expected to remain well into the 1990s.

VF-24 and VF-211 became the eighth and ninth squadrons to receive F-14s.

JANUARY - 1976:

The top aircraft procurement item in the Navy's fiscal 1977 budget was the F-14. The Navy was requesting funding for thirty-six aircraft on the way to a target of 403 aircraft, 390 of which would equip eighteen squadrons, with thirteen aircraft for attrition.

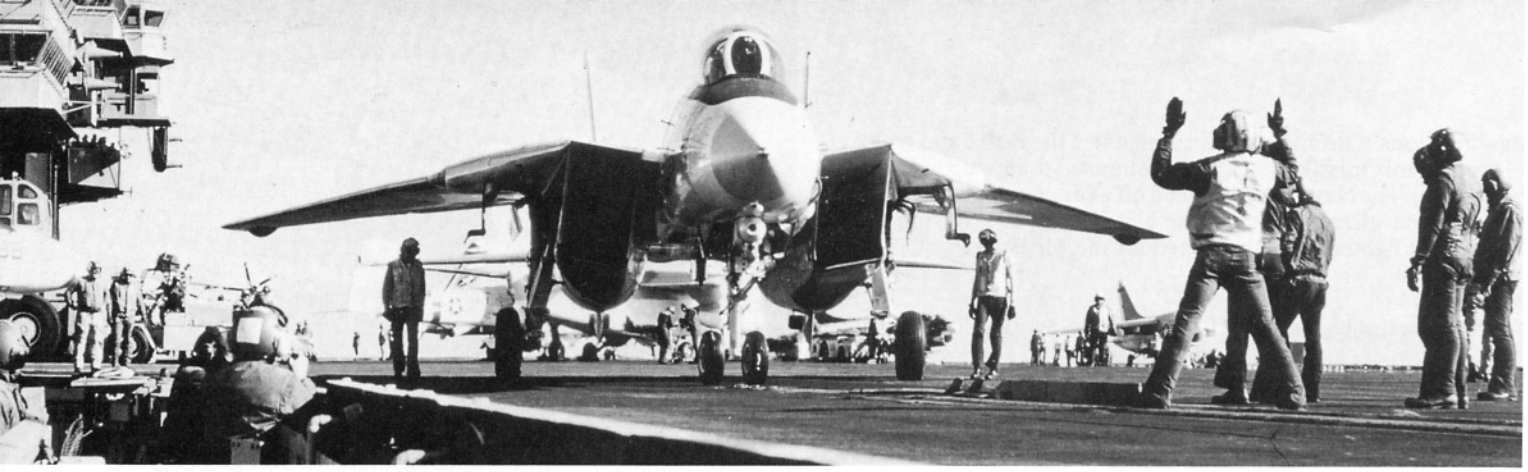
The first IIAF F-14 made its initial flight from Grumman's flight test facility at Calverton, N.Y. The first two Iranian Tomcats arrived at Khatami Air Base, near Isfahan, Iran on 30 January.

VF-14 and VF-32 returned to NAS Oceana after completing the first East coast Tomcat deployment aboard USS JOHN F.KENNEDY (CVA-67) in the Mediterranean.

APRIL - 1976:

The second east coast deployment of Tomcats got underway as VF-142 and VF-143 sailed for the Med aboard USS AMERICA (CVA-66).

This F-14A (BuNo 158614) was also used during carrier suitability testing aboard USS FORRESTAL. The aircraft conducted the tests in a clean configuration carrying no external stores. (U.S. Navy)



As the catapult crew stands-by, a plane director signals the pilot of Tomcat 614 into position on one of the forward catapults aboard USS FORRESTAL during carrier suitability testing. (U.S. Navy)

JULY - 1976:

Fifty-five of 223 F-14s were temporarily grounded, pending modifications to the main landing gear support bulkhead after fatigue cracks were found in some high-time aircraft.

The Navy reported that it would experience shortages of about forty tactical aircraft per year beginning in 1981 and asked for increased production of the F-14.

A General Accounting Office report on the F-14 indicated that the average operational readiness rate was only 37.2 percent. The poor rate was attributed to equipment and inadequate supply support problems. The current rate for F-15s at Luke AFB was 33 percent, while the rate aboard aircraft carriers for F-14s was 80 percent because the Navy strips its shore-based facilities to equip the deployed carrier air groups.

In a test of the AWG-9 weapons system against a simulated MiG-25 threat, a rocket-assisted AQM-37A drone was accelerated to Mach 2.2 at 82,000 feet. An F-14 flying at Mach 1.2 and 47,000 feet launched a Phoenix missile against the drone at a range of 34.8 nautical miles. The missile scored a direct hit. In another test at medium altitude, a QF-9 target drone flew an attack profile at Mach 0.8 at 30,600 feet with a BQM-34A drone equipped with a noise jammer flying twenty-five miles behind it to cover its approach. The F-14 detected the QF-9 and fired a Phoenix at twenty-five nautical miles (a direct hit). The BQM-34A was fired on at forty-seven nautical miles (same results).

While continuing development of the F-401 engine, Pratt & Whitney proposed improvements in the TF-30, which included redesign of the first stage fan blade and a fan case containment, for production deliveries in 1977.

JANUARY - 1977:

Naval Air Systems Command announced improvements in the F-14 which included installation of automatic maneuvering flaps/slats, replacement of the central air data computer and installation of a new UHF radio in block 90 aircraft. Block 95 aircraft would get additional improvements which included TF-30-P-412A engine improvements, changes to the vertical display indicator group and incorporation of fire extinguisher bottles and fire containment measures. The major engine improvements were relocation of the engine shroud and new, tougher fan blades.

Block 100 aircraft were further improved with a slip clutch and coupler installation in the flap/slap system, fuel system changes that included new valves and indicators for transferring fuel, AWG-9 fire control reliability changes, and preventive measures and procedures to eliminate water intrusion of the airframe which had been damaging electronics. New surface seals, drain holes and baffles were incorporated.

MARCH - 1977:

Following inauguration of the Carter Administration, the Navy was forced to examine several drastic alternatives due to funding cutbacks. One of the alternatives considered was cancellation of the procurement contract for additional F-14s.

The House Armed Services Committee elicited a commitment from Navy Vice Admiral F.C. Turner, deputy Chief of Naval Operations, air warfare, to submit a proposal to congress for a new engine for the F-14. This came after the committee determined that the $15 million it had appropriated for this project the previous year had not been used. The Admiral stated that the Navy wanted the new engine, but felt it was more important to fix the engines they had. The estimated cost to modify existing TF-30 engines was $1 million per aircraft. The Navy planned to develop the new F-14B engine on a schedule that would bring it into the inventory during 1984.

This F-14A (BuNo 158620) was assigned to the Strike Test Directorate, Naval Air Test Center (NATC), Patuxent River, Maryland, during October of 1982. The aircraft carried the NATC code 7T on the fin along with the test center badge. (D.F. Brown)

APRIL - 1977:

Joint USAF/Navy test forces began a review of the air intercept missile evaluation (AIMVAL) program which was run at Nellis AFB. The F-14 achieved operational readiness rates of 84 percent, against F-15 rates of 63 percent.

JUNE - 1977:

The first Tomcat to log 1,000 flight hours was number 9, which passed the milestone on 28 June during a Phoenix missile test at NAS Point Mugu, Calif. Tomcat No. 9 had arrived at Pt. Mugu during December of 1971 with a total of 6.3 hours.

OCTOBER - 1977:

VF-114 and VF-213 began their maiden F-14 cruise aboard USS KITTY HAWK (CVA-63).

The second half of the joint USAF/Navy ACEVAL (Air Combat Evaluation) was completed at Nellis. Preliminary results showed the importance of the new Television Sighting Units (TVSU) for the F-14. 185 missiles were fired electronically. On 175 of these firings, the TVSU was used for long-range visual identification (beyond ten miles for fighter sized targets, as much as seventy miles for jumbo-jet size targets). The TVSU provided a visual image on the pilot's screen when the target was locked up by the F-14's radar.

DECEMBER - 1977:

VF-41 and VF-84 began their maiden F-14 cruise aboard USS NIMITZ (CVN-68).

FEBRUARY - 1978:

As the Carter Administration continued to cut back on the Defense budget, some defense contractors appealed directly to the public sentiment. Grumman took out a full page ad in Long Island's daily paper, Newsday, in which Chairman and President George Skurla stated that the proposed Defense Department cut of 1980 F-14 production from sixty to thirty-six and finally to twenty-four was a serious threat to the economy of Long Island and to the defense of the nation.

DECEMBER - 1978:

Iran takes delivery of the last of seventy-nine F-14s (the 80th aircraft remained in the United States for use as a test bed for future improvements).

APRIL - 1979:

The Ayatolla Khomeini returns to Iran, sparking a revolution which would lead to the end of U.S. foreign and military aid.

NJ 452, an F-14A Tomcat (BuNo 162590) of VF-124, the West Coast training squadron, makes a high-G turn over Brown Field, California, on 14 May 1988. One of the Tomcat's outstanding characteristics is its ability to turn inside of many of its contemporaries. (Ted Carlson)

AUGUST - 1980:

VADM George E.R. Kinnear, II, Commander, Naval Air Forces-Atlantic, held a press briefing at NAS Oceana on 18 August to discuss the readiness of Atlantic Fleet F-14s. VADM Kinnear's statement included the following quote: "In the decade since the Tomcat's introduction, we have witnessed unprecedented Soviet advances in the entire spectrum of threats to the carrier battle group and the F-14 is the only aircraft in the U.S. inventory with any ability to counter these threats to the carrier force and simultaneously establish maritime air superiority." Such was the state of the U.S. defense posture after four years of the Carter Administration that a handful of fighters were the sole defense of one of America's defense triads. It was reminiscent of 1939-40.

Tomcat "Ski Jump" feasibility studies were conducted using a Naval Air Test Center F-14A and a nine degree ski ramp constructed at the Naval Air Test Center, Pax River, Maryland. (U.S. Navy)

H-29 was one of the F-14As destined for Iran. The Imperial Iranian Air Force received seventy-nine Tomcats out of their total order of eighty aircraft. Iran was the only foreign user of the F-14 and, since the overthrow of the Shah, Grumman has not supported these Tomcats. (Grumman)

OCTOBER - 1980:

Grumman announced that it would test the General Electric F-101X engine in the F-14. Three of the engines, which were variations of the engines built for the B-1 bomber, were built for Grumman. General Dynamics announced that it would also test the engine in the F-16. The F-16 used the F-100 engine, which had suffered as many problems as the TF-30 engine used by the F-14.

JANUARY - 1981:

Using 140 computer controlled jacks, Grumman is able to apply all the pressures encountered by the F-14 during all phases of its operational profile, without ever flying the Tomcat. F-14 number 98 underwent tests which simulated up to sixty flights a day in Grumman's Plant 5. The reason for these tests was to determine the structural life of the Tomcat; then find ways to lengthen it. The reason the Navy wanted this done was that there was no aircraft on the horizon which could replace the Tomcat and even if one were funded in the near future, the ten to twelve year acquisition cycle would go far beyond the design life of the F-14.

MAY - 1981:

The 400th F-14 rolled off Grumman's Calverton assembly line on 27 May. It was scheduled to enter service with one of the first Tomcat squadrons, VF-1, based at NAS Miramar, California.

JULY - 1981:

Grumman Test Pilots Joe Burke and Roger Ferguson made the first flight of the Super Tomcat, an F-14 equipped with F-101 DFE engines. Before the engines were installed in the F-14, they had been subjected to over 2,000 simulated fighter missions at the General Electric Evendale facility in Ohio under an accelerated mission testing program. The first flight lasted ninety minutes and was a complete success. The F-101 engines had 29,000 pounds of thrust, compared with 21,000 pounds for the trouble plagued TF-30s used in production F-14s.

AUGUST - 1981:

Pratt & Whitney Aircraft Group announced a number of changes to the TF-30 engine in the F-14. Improvements included increased time between hot section inspections (from 500 hours to 1,000 hours), an engine replacement interval extension (from 1,100 hours to 2,400 hours) and overall durability improvements.

Tomcats from VF-41 engaged a pair of Libyan Su-22 Fitters after being fired upon by the lead Fitter over the Gulf of Sidra. Both Libyan aircraft were shot down with AIM-9 Sidewinders.

OCTOBER - 1981:

The twenty-two flight Grumman test program of the F-101 engined "Super Tomcat" concluded with enthusiastic praise from Grumman's chief test pilot, Chuck Sewell, who said: "The F-101DFE Tomcat is a fighter pilot's dream."

Hughes Aircraft Company delivered the first of thirty pilot production models of its improved AIM-54C Phoenix. The AIM-54C was the first significant improvement in the Phoenix since it became operational during 1974. The Navy also announced the addition of medium pulse repetition frequency to improve raid resolution and enhance the ability of the AWG-9 radar to see through clutter.

Tomcats from USS EISENHOWER flew reconnaisance missions over Lebanon in support of the U.N. peace keeping force. During the time that USS EISENHOWER and USS INDEPENDENCE air groups supported the peace keeping force, they were frequently fired upon by Syrian gun positions and an A-6 and A-7 were shot down by ground fire. Tomcats flew cover for all missions but were never challenged by MiGs.

JANUARY - 1982:

LCDR Vince Lesh and LCDR D.C. Smith took delivery of the 500th F-14 at Calverton and flew it to VF-1 at NAS Miramar.

APRIL - 1983:

All production F-14s are equipped with Northrop's Television Camera System (TCS). TCS features a stabilized closed-circuit television and precise optics which allow the crew of the Tomcat to acquire and identify targets at beyond visual range.

FEBRUARY - 1984:

The Navy announced that the F-14D could be powered by the General Electric F-110-GE-100 engine instead of the Pratt & Whitney TF-30. Secretary of the Navy John Lehman said that the Navy wanted to acquire 300 F-14Ds.

AUGUST - 1984:

The Navy approved procurement of the F-14D, which would feature more powerful engines, digital avionics and an improved fire control system. Procurement of a new version of the Tomcat ensured that the F-14 would remain in service with the Navy well into the 21st century.

JUNE - 1985:

Iraq claimed that its Mirage F-1 fighters, equipped with Matra 530 air-to-air missiles, had shot down twelve to fourteen Iranian F-14s during the course of the Iran-Iraq war. Later information revealed that superior Iraqi tactics had played a major role in these victories.

OCTOBER - 1985:

F-14s played a pivotal role in one of the few victories against international terrorism. When the Palestinian terrorists who had hijacked the Italian cruise ship ACHILLE LAURO and killed sixty-nine year-old American tourist Leon Klinghoffer received asylum in Egypt, it looked as though they would get away with murder. NSC counter-terrorist expert LTCOL Oliver North hatched a plan to intercept the terrorists if they left Egypt by air. When they did, F-14s from USS SARATOGA, aided by E-2 radar aircraft and EA-6B electronic jammers, intercepted the Egyptair 737 and forced it down on Sicily, where the terrorists were taken into custody by Italian officials. They were later tried and convicted.

FEBRUARY - 1986:

The Navy announced plans to lower its request for F-14As during fiscal 1987 until it could start receiving F-14Ds. The fiscal 86 budget contained funds for eighteen F-14A+s. An additional fifteen were requested for FY 87, while half of the twelve Tomcats slated for acquisition in FY 88 were to be A+s and half F-14Ds. Production of the F-14D was planned to reach 36 by fiscal 1991.

Testing of the General Electric F-110-GE-400 engine which would power the F-14A+ and F-14D began at GE's Evendale, Ohio plant.

MARCH - 1986:

In response to further Libyan provocations in the Gulf of Sidra, which included firing SAM missiles at U.S. aircraft over inter-

national waters, the U.S. Sixth Fleet conducted strikes against Libyan military targets. F-14s provided air cover for the A-7s, A-6s and F/A-18s.

JULY - 1986:

The Navy announced that it would forego the long and arduous process of acquiring the Advanced Tactical Fighters (ATF), an all-new fighter/attack aircraft, in favor of upgrading the F-14A to F-14D specification and the A-6 to A-6F standard. Navy project manager CAPT William Bowes said of the F-14D: "The fighter of the future, which can stand alone on its merits into the 21st century. The really exciting thing about the F-14D program is its sensor ability, in correlating all that information coming from the avionics suite, correlating one sensor with another to the point where the F-14D can lock on to three targets and fire weapons."

SEPTEMBER - 1986:

The first F-14A+ made its maiden flight. Grumman test pilot Joe Burke was at the controls for the "routine" first flight of the interim F-14 improvement, awaiting production of the F-14D.

DECEMBER - 1986:

The first of twenty-five F-14s being reworked for Naval Reserve squadrons VF-201 and VF-202 made its first flight. The twenty-five Tomcats had been used as test aircraft or were in storage. They were brought up to current fleet standard with rewired airframes, new avionics and reworked engines.

APRIL - 1987:

The number 13 F-14 was modified with yaw vanes mounted between the engines. Test flights confirmed flight characteristic predictions by the designer, David Taylor of the Naval Ship Research and Development Center. The yaw vanes were installed as an inexpensive method of simulating future powered yaw and thrust vectoring modifications proposed by the Defense Advanced Research Projects Agency (DARPA).

NOVEMBER - 1987:

The Navy accepted the first production F-14A+ at a roll-out ceremony at Grumman's Calverton plant. Grumman announced plans to build thirty-eight production F-14A+ and to upgrade thirty-two older F-14As to the A+ standard, which included new General Electric engines which gave the Tomcat thirty percent more thrust and new avionics. The first A+ made its maiden flight that same month, with Kurt Schroeder at the controls and Ed Flanagan in the back seat.

The F-14D avionics development aircraft made its first flight at Calverton, with David Kratz at the controls and Tony Springs flying as RIO. It reached an altitude of 40,000 feet and a speed of Mach 1.6 during the 1.25 hour flight.

Hughes announced a hybrid radar for the F-14 which would provide improved target detection and tracking, better electronic-countermeasures, and beyond visual range target identification and raid assessment modes. The AN/APG-71 would have 86% commonality of signal processors with the AN/APG-70 radar installed in USAF F-15C/D/E fighters.

APRIL - 1988:

VF-101 took delivery of the first operational F-14A+ at NAS Oceana.

AUGUST - 1988:

The first hint of a Tomcat improved beyond the F-14D specification came in the announcement from Grumman that rapidly emerging technologies could be integrated into the F-14 airframe to provide an even more effective fighter for the 21st Century. Among the improvements mentioned were sensor fusion in the AN/APG-71 radar, TV camera and infrared search and track sensors, fighter-to-fighter data link and radar improvements which would reduce clutter in overland operations. Also mentioned was the possibility of adding AAMRAM and HARM missile capabilities.

The pilot and RIO of this VF-142 Ghostrider Tomcat man their aircraft during Strike Warfare Training at NAS Fallon, Nevada. The Naval Strike Warfare Center (NSWC) was dedicated at NAS Fallon in the Fall of 1984 and is to the attack community what Top Gun is to the fighter community. (Robert L. Lawson, Tailhook Photo Service)

NOVEMBER - 1988:

Grumman offered the Tomcat 21 as an alternative to the Navy Advanced Tactical Fighter (ATF). Congress continued to insist upon more commonality between Navy and Air Force aircraft, forcing the Navy to consider a version of the USAF ATF. Shrinking budgets, however, seemed to militate for upgraded versions of existing tactical aircraft rather than new designs.

The Tomcat 21 would incorporate a redesigned airframe which would reduce the aircraft radar signature, air-to-ground weapons delivery capability and emerging technologies.

JANUARY - 1989:

Two F-14s from USS JOHN F. KENNEDY shot down two Libyan MiG-23s while on combat air patrol. The JFK was conducting routine air operations south of the island of Crete. The two F-14s were stalked by the MiGs and when the Libyan fighters closed to within missile range, the F-14 flight lead decided to attack. He fired two AIM-7 Sparrows, one from twelve miles, one from ten miles. Both guided but neither hit. The F-14s split, with the MIGs both going for the F-14 wingman, who reversed and fired a Sparrow from five miles. The AIM-7 hit the Libyan wingman. The lead F-14 had reversed and fired a Sidewinder from 1.5 miles behind the Libyan leader. The AIM-9 guided and hit the lead MiG. The action took place seventy miles north of Tobruk, over the Gulf of Sidra.

MARCH - 1989:

Deliveries of F-14A+ were on track with a total goal of seventy aircraft, thirty-eight of which would be new production and thirty-two as retrofits. The last F-14A+ delivery was scheduled for February 1990. The Navy planned to buy a total of 527 F-14Ds, 127 new production, while the balance would be remanufactured F-14As. The first production F-14D was scheduled for delivery to the fleet during March of 1990.

MARCH - 1990:

First production F-14D is completed. Plans call for twelve new production F-14Ds and six remanufactured F-14As to be delivered during 1990.

JUNE - 1990:

First F-14A arrives at Grumman to start the rebuild cycle. The rebuild program takes some fifteen months to complete.

SEPTEMBER - 1990:

Second F-14A arrives at Grumman. Current F-14D Program still calls for 127 new production F-14Ds and rebuild of 400 F-14As to F-14D standard.

CHUCK SEWELL

Of all the test pilots to fly the F-14, one of the most outstanding was Charles A. "Chuck" Sewell. Sewell joined the Marines and won his Navy wings during December of 1950. He flew 110 combat missions in Korea, including a four month tour as a Forward Air Controller (FAC) with the 1st Marine Division. He was shot down behind enemy lines but, even with a broken arm, he managed a three-day walk and swim before finally being rescued by an American helicopter.

After Korea, Sewell was assigned to exhcange duty with No 74 Squadron, Royal Air Force. His two year tour with the RAF was followed by an assignment to the U.S. Navy Test Pilot School. Following graduation, Chuck spent four years as a test pilot at the Naval Air Test Center, Patuxent River, Maryland.

He flew 220 combat missions in Vietnam as a Marine F-4 squadron commander. Following his tour in Vietnam, the Marines assigned him to a desk job in the Pentagon. Chuck did not want to give up flying and decided to retire from the Corps rather than shuffle papers. He retired from the Marine Corps as a Lieutenant Colonel. His decorations included the Legion of Merit, two Distinguished Flying Crosses, fifteen Air Medals and two Purple Hearts.

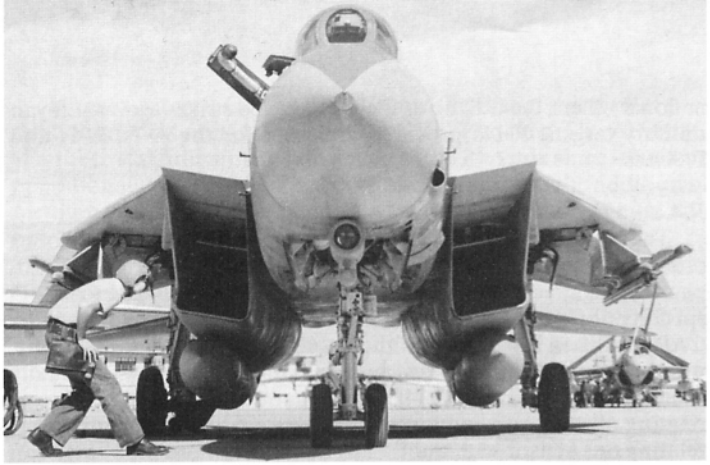
Sewell joined Grumman during 1969 as an Experimental Test Pilot and he was promoted to Chief Test Pilot during 1971. His accomplishments were many and varied, including the spin evaluation and demonstration on the EA-6B, first flight and structural tests of the KA-6D, initial flight envelope expansion and high angle of attack testing, M-61 cannon testing, stall/spin prevention system, asymmetrical thrust testing of the F-14A, structural and systems development flight tests on the EF-111A, and A-6 Circulation Control Wing and in-flight thrust control tests. He performed the first successful supersonic in-flight thrust reversal. He also flew the A-6E HARM structural flight tests.

He was a Fellow in the Society of Experimental Test Pilots and former head of SETP Flight Test Committee. He won the 1973 and 1984 Kincheloe Award as Test Pilot of the Year. He was winner of the 1974 American Institute of Aeronautics and Astronautics Octave Chanute Award. His awards were not just confined to flying. He won Best Technical Paper of 1979 Award from SETP, Best Technical Paper Award at the 1982 European Society of Experimental Test Pilots Symposium, and the Ray E. Tenhoff Award from SETP for the most outstanding paper at the 1983 symposium.

Chuck Sewell was one of the prime movers of the F-14 program. He was revered by his fellow test pilots as one of the very best pilots they had ever flown with, capable of pushing the outer edge of the envelope. He flew 140 different aircraft types during his career, including the first flight of the radical X-29 during 1984.

He made his last flight on 4 August 1986. Ironically, it was not one of the ultra-sophisticated Mach busters that killed Chuck Sewell. It was a Second World War vintage Grumman TBF Avenger torpedo bomber. He had agreed to ferry the aircraft to Florida from Connecticut, a trip that put an end to the career of one of the best test pilots to ever strap on a new airplane. The old torpedo bomber developed engine trouble shortly after takeoff, crashing into the woods off the end of the runway at Brooklyn, Connecticut.

Asymmetrical flight trials were conducted by Chuck Sewell, who made six flights with the starboard wing locked at 20 degrees of sweep. The left wing was positioned at 35, 50, 60, and 68 degrees while in the air. The tests took place at Calverton between 19 December 1985 and 28 February 1986. (Grumman)



The plane captain of this F-14 performs his final checks before waving his charge out of its parking spot on the NAS Fallon ramp. The refueling probe is deployed so that it can be inspected before the aircraft departs on its training mission. (Robert L. Lawson, Tailhook Photo Service.)

EMORY BROWN

My interview with Emory Brown took place during 1977 and was included in my "F-14 Tomcat In Action." I include it here for two reasons: my "F-14 Tomcat In Action" is out of print, and Brown's recollections of his Tomcat testing experiences dovetail so well with those of Gene Tucker and Rick Hauck, whose interviews follow.

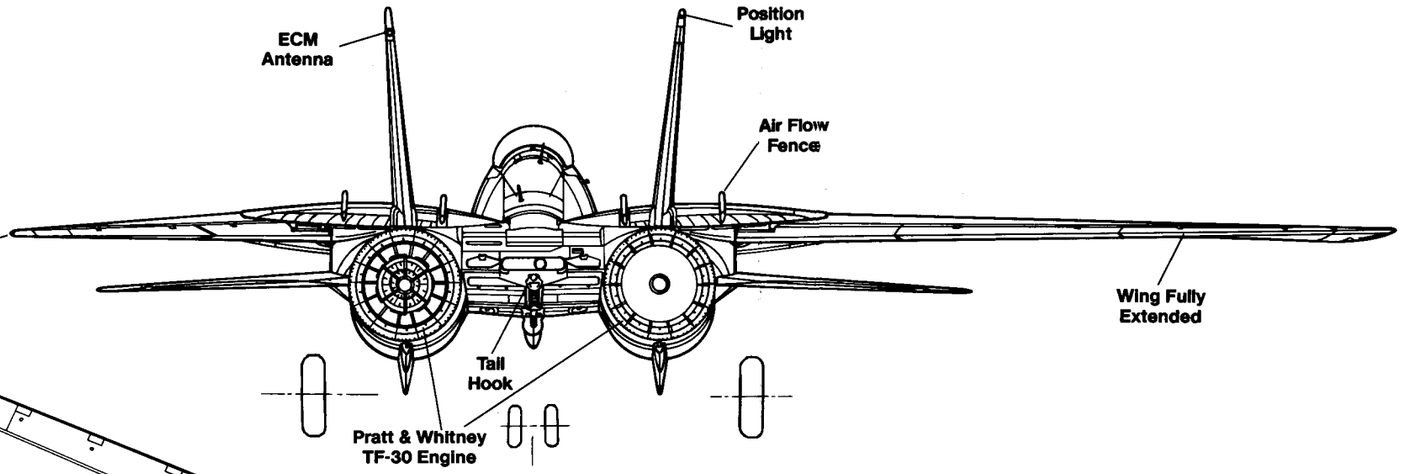
When I interviewed Brown during 1977, he had accumulated over 4,000 hours of jet fighter time, including 750 hours in the F-14. He had made one operational F-14 cruise with VF-142 aboard USS AMERICA (CV-66). His experience included combat cruises in the F-4 with both VF-11 and VF-102. He was a graduate of the U.S. Navy Test Pilot School and served with the Carrier Suitability Branch at the Naval Air Test Center, Patuxent River, Maryland. He was the F-14 OPEVAL Project Manager and as such was the fourth Navy pilot to fly the F-14 and the first to land a Tomcat aboard a carrier (during the F-14's initial carrier qualification trials). He later commanded VF-84.

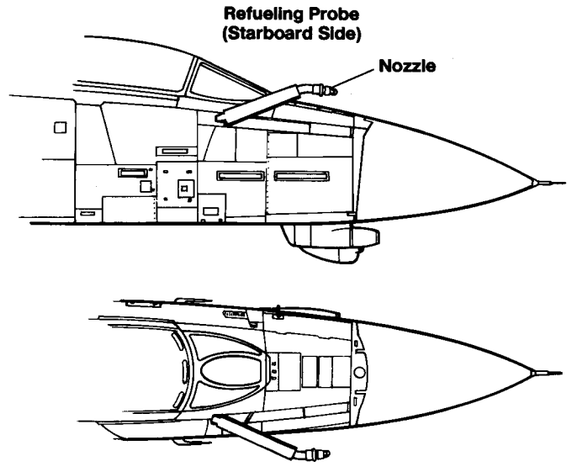
"One of the primary lessons taught at Test Pilot School was avoidance of emotional involvement in a test project. We learned that lesson well and I assure you that the precept was retained for at least two days following my assignment to the F-14 carrier suitability project. The sudden responsibility for ensuring accurate and complete testing, objective analysis and acceptance or rejection of design features of the next generation Navy fighter fell on the shoulders of a few test pilots and project engineers. Emotional involvement?...You bet!! We lived F-14 for three years of program monitor and flight testing. They were complex years, made up of frustration, extraordinary satisfaction, highs, lows, politics, professional accomplishment, physical/emotional fatigue and the best flying this side of combat.

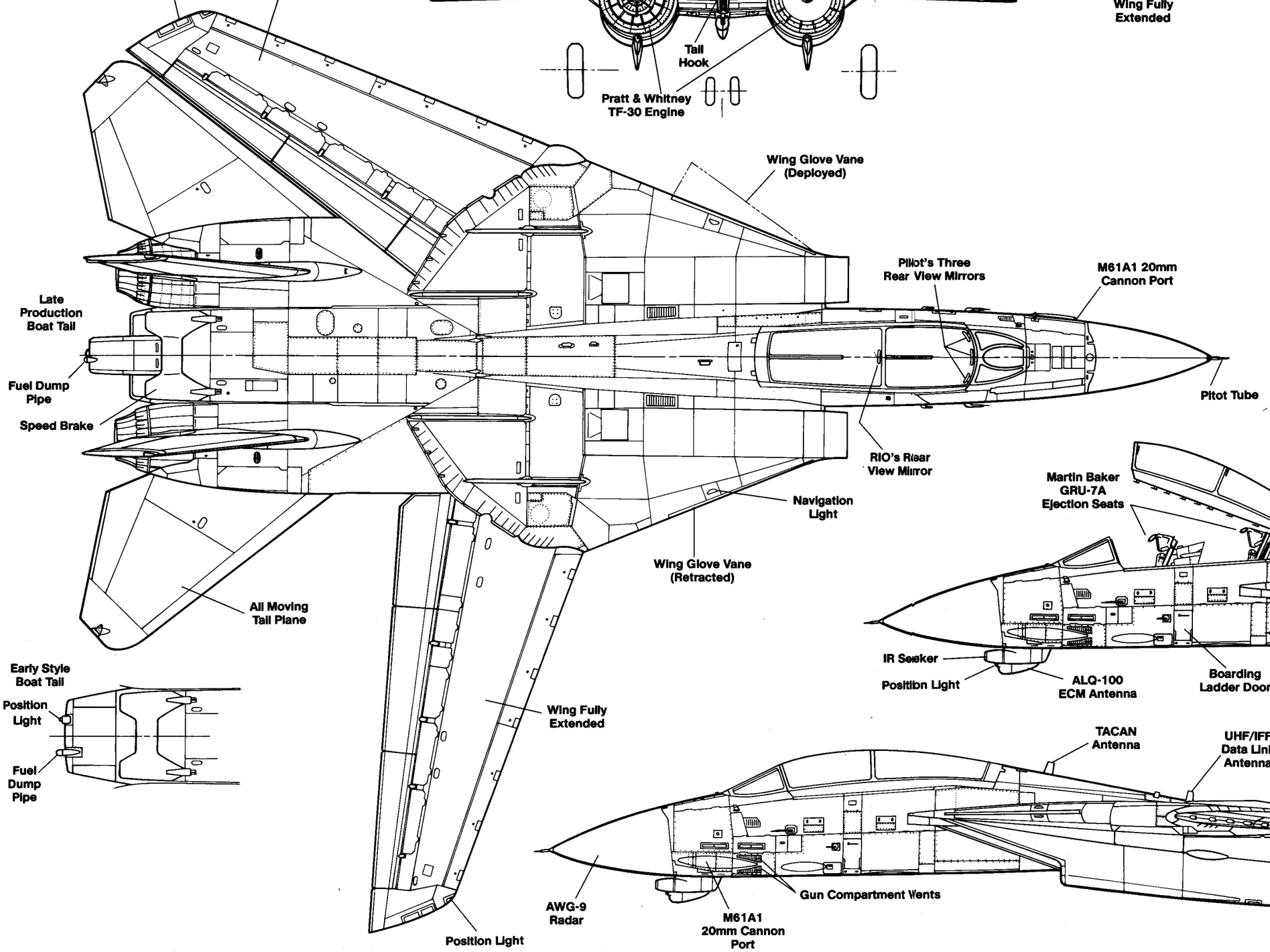
The product does not have all of the flying qualities for all of the capabilities that we as test pilots, soon to be returned to the fleet and operational flying, would have desired. But it is unquestionably a superior weapons system and a mean flying machine. I feel a tremendous sense of accomplishment and pleasure in recalling my professional association with the development of the Tomcat.

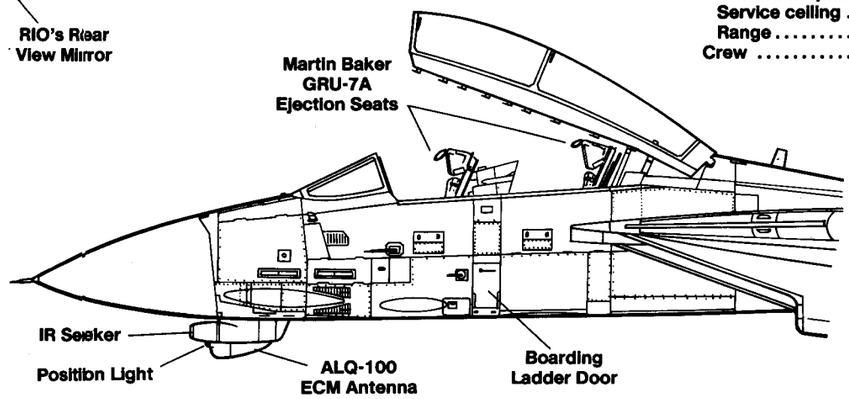
I joined the F-14 Evaluation Team immediately upon graduation from TPS, while the program was still in a monitor status, and remained with it until the beginning of Board of Inspection and Survey (BIS) trials. BIS trials are the last step in the Navy's evaluation of a new aircraft before it is accepted into the fleet. CDR George White was the team leader and the flying qualities and performance specialist. The team that I will be referring to consisted of six pilots, two each from Carrier Suitability and Flying Qualities and Performance (Flight Test), and two from the fighter branch of Service Test, whose specialty was engines.

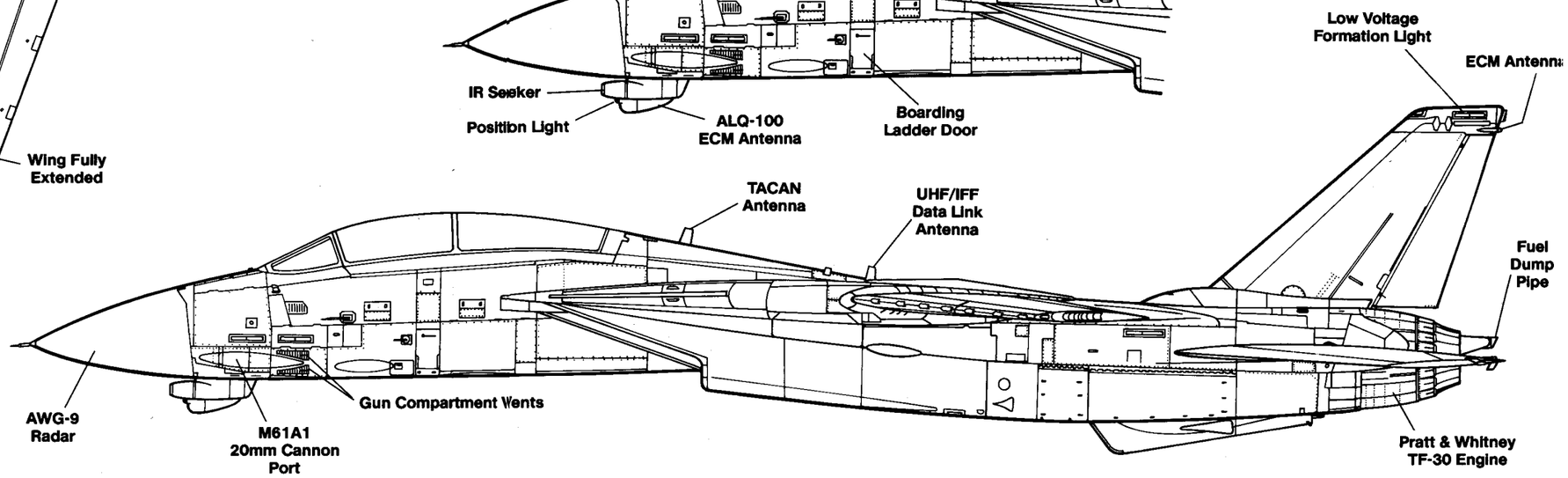
My partner was LCDR Gene Tucker, a superb fighter pilot and a totally dedicated, professional test pilot. Gene and I had











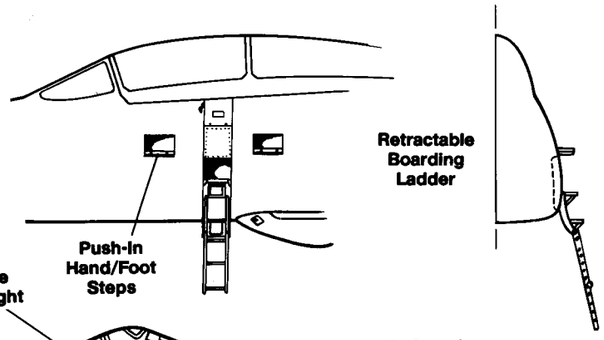
Specifications

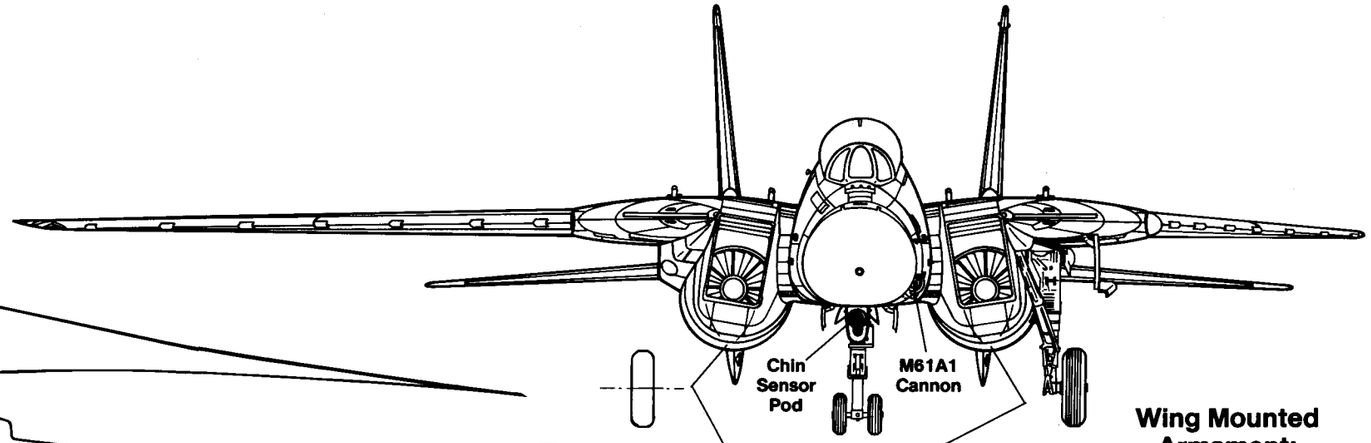
Grumman F-14A Tomcat

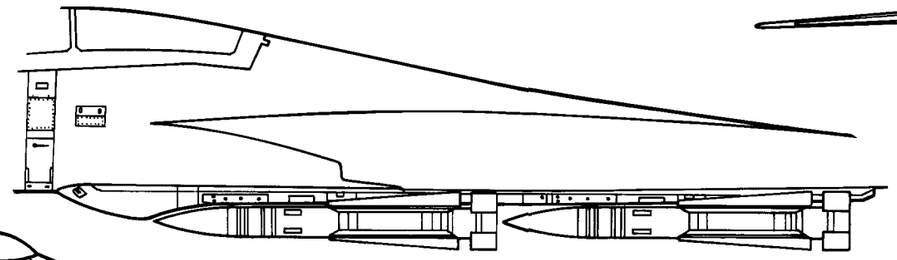
Wingspan	64 feet 1½ inches (unswept) 38 feet 2½ inches (swept)
Length	62 feet 8 inches
Height	16 feet
Empty Weight	40,104 pounds
Maximum Weight	74,349 pounds
Powerplants	Two Pratt & Whitney 20,900 lbst TF-30-P-412A turbofan engines
Armament	One M-61A-1 20MM cannon (internal), six AIM-54 Phoenix or six AIM-7 Sparrow missiles and two AIM-9 Sidewinder missiles.
Performance	
Maximum Speed	1,544 mph
Service ceiling	50,000 feet
Range	2,000 miles (with tanks)
Crew	Two

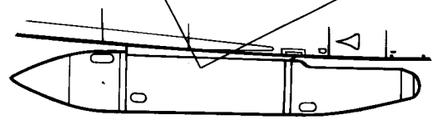
M
Ft.

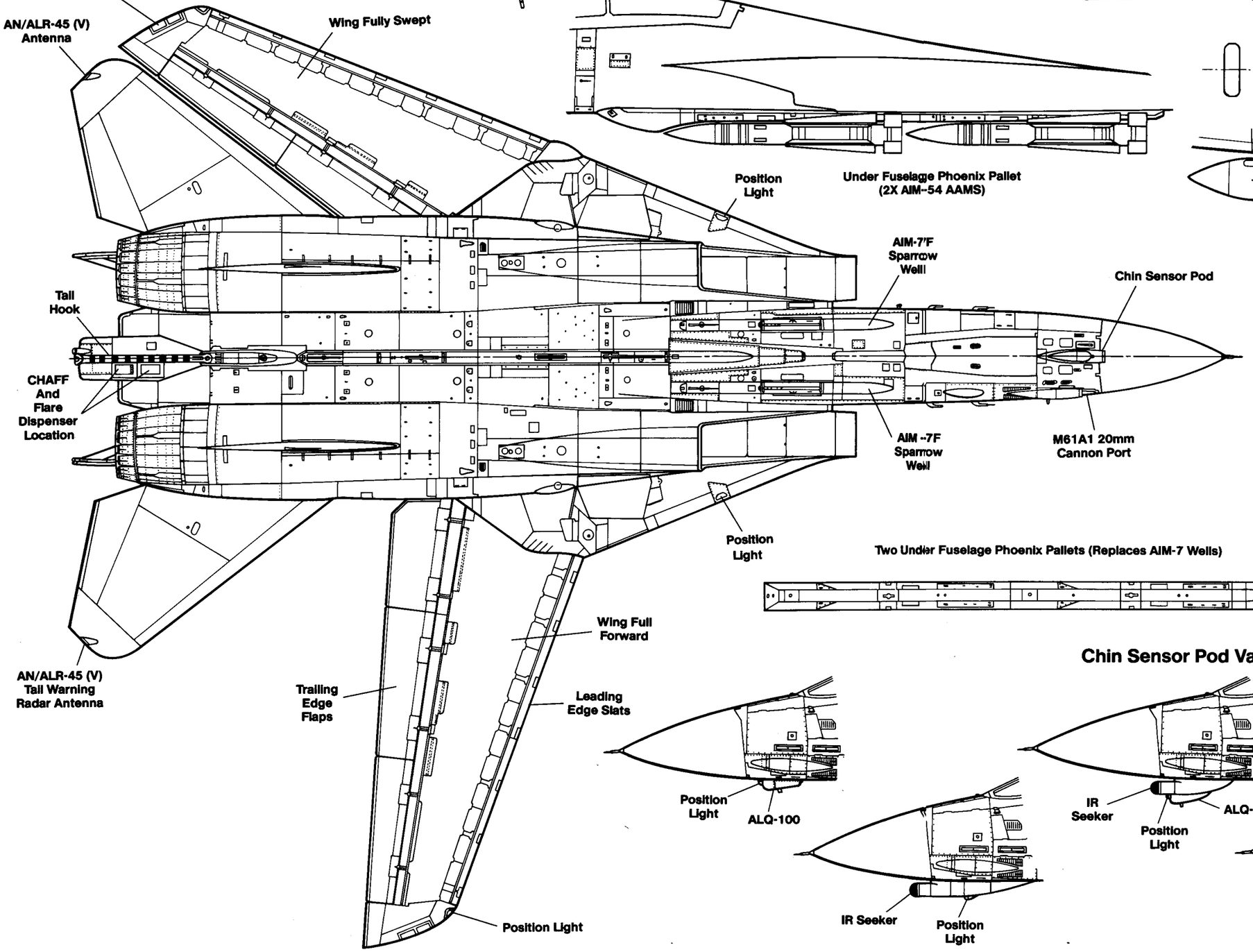
Scale 1" = 6'



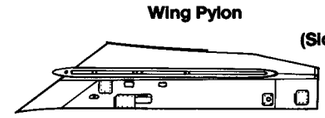


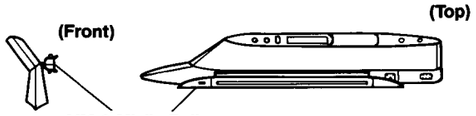


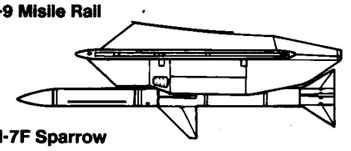


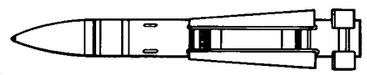


Wing Mounted Armament:

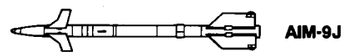


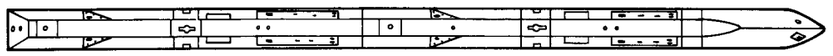






SIDEWINDERS





Chin Sensor Pod Variations

seen combat in sister squadrons, where we had developed a strong friendship and mutual respect. During the initial evaluation of the aircraft we found that our previous association and sense of loyalty was the key element in a fight that essentially pitted Carrier Suit against the Fleet, Grumman, Naval Air Systems Command and other members of the evaluation team. Sounds like heavy odds, doesn't it? The subject of this massive hassle was Direct Lift Control (DLC), a concept that had been partially tested in the F-8, but first incorporated in the F-14 as a production feature. But, more about DLC later.

The first Navy Preliminary Evaluation (NPE-1) followed a year of monitor, during which we practically commuted between Patuxent River and the Grumman plant on Long Island. During this period, the NPE team and Bill Miller, who was F-14 Project Pilot for Grumman, and probably the most significant contributor to the excellence of the aircraft, became deeply involved in training on aircraft systems and analysis of contractor test flight results. We began to sense areas that required a closer look and to develop our flight test plans accordingly. We also became acquainted with a totally new concept in data acquisition, which was to revolutionize flight testing. The Automated Telemetry System (ATS) was designed to monitor aircraft systems, engine parameters and flight data in real time, which enabled the pilot to concentrate with precision on his particular test, while the ATS specialist monitored operating limits. An immediate readout permitted immediate repetition of the test, if required and validated results of a good test. Its almost impossible to stress too much the importance of ATS to the F-14 program.

The NPE-1 provided us with our first opportunity to fly the aircraft. The psychological and emotional pressures that followed covered a wide spectrum. The sheer excitement of strapping on the most advanced tactical fighter aircraft in the world. from brake release to lift off in 1,200 feet, rotating immediately to 70 degrees nose up, then looking over your shoulder as you pass through 15,000 feet and seeing that you are still within the airport boundaries...well, that's exhiliarating!

But the return to reality and objective analysis must be immediate, since the test plan permits only eight carrier suitability flights during NPE-1. I had to stifle the urge to leave her in zone five afterburner and recite "High Flight" over and over and over again. At that moment, there was no man in the world that I would have traded jobs with.

My immediate reaction, from a technical standpoint, was that of a tight, responsive control system, tremendous power and an exceptionally honest aircraft. The high Alpha (angle of attack) characteristics were most impressive, and the controlabiltity afforded by the two large vertical tails and rudders was remarkable. The F-14 is a true stick and rudder aircraft that will perform unbelievable moves in the hands of a fighter pilot. The human engineering that Grumman designed into both cockpits was a work of art, with all controls within easy reach. I was so totally impressed with the machine that I became concerned about my ability to remain objective. But that quickly passed as the test plan prosecution began. The hot mike interchange with ATS, during which every comment was taped along with the data, tends to tone down ICS commentary and remind the pilot of his primary mission.

I was to devote a majority of my flight time during NPE-1 to the power approach (landing) configuration and on one flight actually conducted ninety-two field carrier landing practice approaches. We refueled twice during that test flight, a practice which, like the ATS, had a revolutionary effect on flight testing. That particular flight was a 5.7 hour endurance test...an unbelievably long time for a fighter pilot with a 2.1 hour tail bone. We looked at every imaginable combination of flap, wing sweep, speed brake, auto-throttle and DLC configurations with capability to correct to glide slope for all potential error situations that a carrier pilot might experience. We flew from high fast starts, to low slow starts, to settles at the ramp/climbs at the ramp

LCDR Rose (call sign Tokyo) and LCDR Nagelin (call sign Trigger) man their F-14A of VF-302 during carrier operations aboard USS CONSTELLATION (CV-64) in January of 1987.

and evaluated aircraft response to corrections. We found some interesting results, particularly considering that the aircraft was advertised to be better at the back end of the boat that anything in the inventory.

Direct Lift Control (DLC) is a landing aid, provided by the four individual spoilers on top of each wing. When DLC is engaged (by pushing a button on the stick) the spoilers pop up to a neutral position. They can be commanded full up (+15 degrees) or full down (-4.5 degrees) with a thumb wheel on the side of the stick. When we became more familiar with it, we discovered that we could make very precise adjustments with DLC, without changing the attitude of the aircraft. There is a stabilator input which compensates, of course, since DLC changes your center of pressure, which in turn changes the pitch attitude of the aircraft. We used DLC in conjunction with auto throttle and the combination is really very nice for flying aboard.

Throughout the test program, Grumman was under the Congressional gun and under public scrutiny for potential cost overruns and all the other transgressions, real or imagined, that apply to the typical defense contractor today. (Author's Note: It should be remembered that Grumman was laboring under a fixed-cost contract that, because of inflation, would eventually bring the company to the brink of bankruptcy. Government negotiators, also feeling pressure from above, were unwilling to relent on the contract. Public disaffection with the Vietnam War was spilling over to all aspects of the military, causing some members of congress to allow their judgement to be clouded by the unpredictable winds of political change.) Grumman was in a tight position and they anticipated that even tighter days were

F-14 pilots and RIOs wait for the beginning of flight operations aboard USS JOHN F. KENNEDY (CV-67) during the NATO Exercise Display Determination 86, held in the Fall of 1986, in the Mediterranean Sea. (U.S. Navy)

The plane captain confers with the pilot of an F-14 aboard USS SARATOGA (CV-60) during flight operations in the Mediterranean during March of 1986. Plane captains are responsible for the daily maintenance of the aircraft.(U.S. Navy)

coming, while they tried to function within the letter of the detail specifications for the F-14 in order to avoid costly penalties.

One primary requirement for the F-14 was for a maximum carrier landing speed of 128 knots. This is a tight restriction for an aircraft capable of speeds in excess of Mach 2.4, but Grumman's swing-wing design managed to accomplish it...except with DLC engaged. DLC adds 6 knots to the approach speed and at max arrested landing weight, it generated a 132 knot approach speed. There were two options as far as Grumman was concerned...increase the optimum angle of attack for approach by two units, thereby slowing the aircraft to 128 knots...or delete DLC.

While furiously lobbying with NAVAIR and the Fleet and attempting to convince us to accept the latter option, Grumman installed a complex dual action angle of attack bug that varied optimum approach selection from 15 units in conventional configuration to 17 units with DLC engaged. The auto throttle computer responded accordingly. Not a bad idea, you might say. Tucker and I both disagreed entirely with the concept and with both of Grumman's options.

The aircraft flies much better at 15 units AOA and must have DLC engaged to generate decent engine response and provide the improved flying qualities that accompany a slightly higher airspeed. Those of us who landed aboard an aircraft carrier on a black, rainy, turbulent night with a very low ceiling and no divert field in the vicinity, will tell you that the epic "High Flight" does not apply during this event. What does apply is rapid and effective response from the flight controls and engines and a stable flying machine.

In deference to those select few of the world's aviators who would fly the F-14 under those conditions, we insisted on a third option...retention of DLC, making it mandatory for night and preferable for day operations, give Grumman relief on the specification requirement for 128 knots approach speed and set the optimum approach at 15 units AOA. Sounds logical and it should have been simple, but it wasn't so simple because Grumman did not believe they could escape the cost penalty. Thus began "The Great DLC Fight Of The Century."

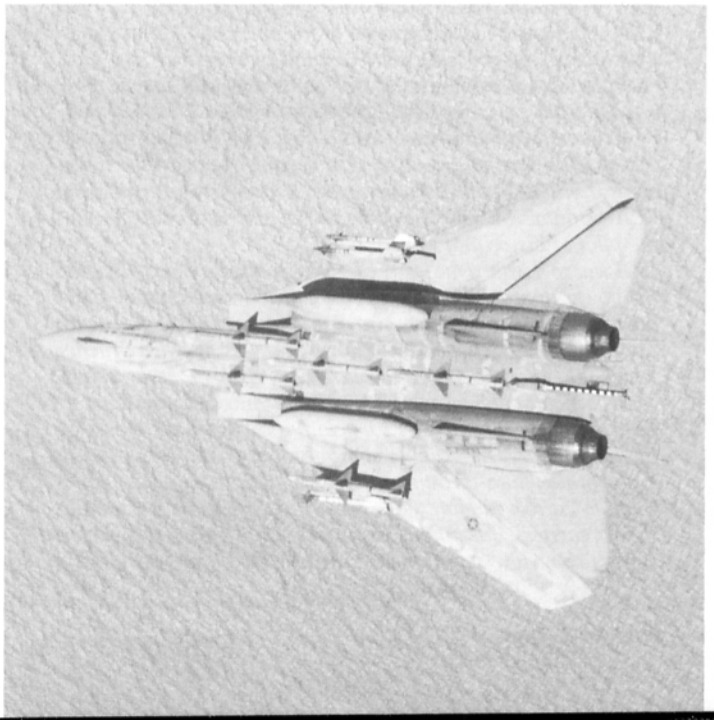
First, let's set the record straight on the F-14 in the carrier landing environment. The rigidity of the design specification for both high and low speed performance requirements generated some features in the landing configuration that increased pilot work load. With training, the basic aircraft (without DLC) can be flown aboard nicely, but honors for the Golden Tailhook (awarded to the squadron whose carrier landing performance is the best within the air wing) are more difficult to achieve than with the F-4. The basic aircraft is perfectly safe, it just isn't beautifully smooth on the glide slope. It has high pitch inertia similar to the RA-5C; float characteristics like the A-6A; residual thrust from the fan engines that keep the throttles in the lower, less responsive zones; a sensitivity to sideslip; a lateral control system (spoilers) that stair-step it with lineup corrections and diminish precise heading control and an auto throttle that requires considerable anticipation. These observations are all relative and I base my analysis on a comparison with all other contemporary fleet aircraft. (Author's note: Emory Brown had flown all contemporary Navy tactical aircraft at the time and he had taken individual Golden Tailhook honors in two air wings while flying the F-4.)

Now I am going to hedge a bit and qualify my statements for those skeptics who will read this analysis and interpret it incorrectly. We have addressed the basic aircraft flying qualities without DLC engaged. To a test pilot whose responsibility is to dissect and evaluate the aircraft, the features discussed are all significant, but the fleet can live with them and perform in a safe environment. Pilot workload is increased by each, but the human being is adaptable. With training and experience he will learn to accept them and to maximize his performance accordingly. The single most significant factor in facilitating pilot adaptation is DLC. The extension of spoilers slightly into the airstream increases drag, which improves flying qualities laterally and longitudinally and thereby reduces the glide slope and lineup problems. Auto throttle capability is also improved with all these factors.

There are still scars all over my body from the DLC caper, but it is in production aircraft and it does accomplish its design task. Without DLC we would have some real problems flying the F-14 aboard ship.

After NPE we had to take the aircraft down to Norfolk and hoist her aboard the USS INDEPENDENCE (CV-60) for deck trials. This was fairly significant because, with congress looking at the aircraft for a possible buy/no buy decision, the most important thing for a carrier aircraft is to be seen on the deck of a carrier. So we drove it around the deck, up and down the elevators...everything short of flying her and gave the ship operators an opportunity to become familiar with the F-14. Then we flew back to Pax River for further contractor demonstrations. They were conducting the carrier arrested landing testing...what we called "shake," which was short for "shake, rattle and roll." We put the aircraft through an awful lot of tough times, taking her up to the limits of her design capability, which include twenty-five foot per second descent rate landings, which the contractor was supposed to demonstrate.

A Tomcat begins a split-S maneuver over the ocean armed with five AIM-7 Sparrows and three AIM-9 Sidewinders plus two external fuel tanks. The AIM-7 is a medium range radar guided missile while the Sidewinder is a short range heat-seeking missile. (U.S. Navy)



During one of these hard landings, Charlie Brown, the Grumman test pilot, hurt his back severely (the aircraft came through unscathed). In flying these tests, I would take the aircraft out and, for instance, start with a three degree glide slope, increasing to 4, 4.5, 5, etc., until we got a high sink rate landing which was the datum point we were looking for. Then we would take it and fly to what we call a roll and yaw opposite, or a roll and yaw same. If it's a "roll and yaw opposite," it's a steady heading sideslip, in which I have 5 degrees right wing down and five degrees sideslip. This is held all the way until touchdown. What we achieve from this is substantial side forces on the second wheel to touch down and it also has a substantial twist on the airframe. A "roll and yaw same" entails flying the glide path and, just before touchdown, applying lateral and directional control inputs.

A missed wire (bolter) is really interesting, because the side of the runway is then sitting in the ground rollout path. That usually required a quick and delicate response to liftoff without getting grass in the mainmounts. Then we would fly a 1-1/2 to 2 degree glide slope, which is very flat, to a free flight engagement. As we approach the runway, we start to increase the angle of attack until we feel the hook dragging on the deck. When it catches the wire, it really slams you down! Then we fly an off-center arrested landing, in which we land 20 feet left or right of the centerline on a very short runout arresting wire. This is a hell of a rough landing! That is a shake...and that is the kind of testing we put the Tomcat through. The concept was to subject the aircraft to the most radical type of landing that might be encountered aboard ship. At the end of these demonstrations we had about another four months of testing to do before we could actually take the aircraft aboard ship.

About that time, the word came down from CNO that there was a lot of talk in Congress about the aircraft not being carrier suitable and there was some talk about scrapping the whole project. All of this talk was the result of people misunderstanding the official technical language that we used in our reports (which had been leaked to people like Jack Anderson, who then printed it out of context) or because of their ignorance of the way aircraft testing is done, drew incorrect conclusions from the wording. For example, we had several categories of deficiencies that we used in grading various aspects of the aircraft. A "preclude" deficiency would "preclude mission accomplishment," a "limit" deficiency would "limit mission accomplishment" and an "avoid" deficiency would be "avoid in future design,", which meant that we could live with it on this aircraft, but don't incorporate the feature in the next aircraft you design. And, of course, topping them all in significance, was the "safety of flight" deficiency. Well, when Congress sights one of these reports, they see that wording and immediately conclude that the aircraft is design deficient. The upshot of the whole thing was that Congressional pressure forced us to take the aircraft aboard ship four months early in order to prove that the F-14 could do what is was designed to do...operate from an aircraft carrier.

The Tomcat is able to engage targets at distances of over 100 miles down to dog fight range. The primary dog fight weapon is the internal M61A1 six-barrel 20MM cannon. The F-14 carries 675 rounds of ammunition giving the pilot seven seconds of cannon fire. As the first air-to-air fighter designed with Vietnam experience, the gun installation received a high priority. (U.S. Navy)

We were forced to give it our best shot right up until the last minute, getting the aircraft ready for carrier operations. Then we made thirteen touch and go landings and two arrested landings on the FORRESTAL and that was our first shipboard experience with the machine. These operations were not without problems. The F-14 has a boosted throttle, which requires about seven pounds of force to actuate. When that fails, it reverts to manual mode, which normally requires fourteen pounds of pressure...and that is very significant!

I had to fly the aircraft aboard ship that way. We also had a wing sweep problem. The flap rigging was giving us problems and the wing would stick at 50 degrees. I had to overcome that problem while airborne, so that I could bring the aircraft aboard ship. During all of this, there was an F-4 waiting on deck, ready to launch with the films of our tests. As soon as we finished, the film was loaded on the F-4 and flown to Andrews AFB where the film was offloaded, rushed to Anacostia for processing and hand carried to CNO, who took it to Congress..just to prove to the people on the hill that we had successfully operated the F-14 from a carrier. It was a shame that we were put through all of that...they knew the aircraft was good and the pressure on us was terrific.

During that period...I believe it was from 9 March until the end of August...we worked from 0600 until 2200...every day... without a day off — Saturday, Sunday, 4th of July..or anything! That encompassed deck trials, carrier preparations, then carrier trials. Shortly after we returned from carrier trials, Bill Miller was killed while practicing for an air show. He was to have done a max performance takeoff, climbing to 2,000 feet, rolling over, and (while turning within the field boundaries) sweep the wings from full forward to full aft. During a practice run he encountered the same problem with the wing that I had, the wing stuck at 50 degrees. We all knew about the problem, and knew that it could be corrected by "tricking" a flap interlock microswitch that wasn't being met.

Red shirts (ordnancemen) load Sparrows aboard a Tomcat aboard USS NIMITZ (CVN-68) off the coast of Beirut, Lebanon during February of 1987. The Sparrow missile is scheduled to be replaced by the AIM-120 Advanced Medium Range Air-to-Air Missile (AMRAAM), which has a launch and leave capability. (U.S. Navy)

This F-14A, on the hangar deck of USS FORRESTAL during the Tomcat's initial carrier qualifications in 1973 is armed with an inert AIM-54 Phoenix missile. The Phoenix has a range of 124 miles and a top speed of Mach 5. The Tomcat can carry six AIM-54s. (U.S. Navy)

VF-1 Wolfpack ordnancemen load an inert practice Sidewinder missile aboard an F-14 on the flight deck of USS KITTY HAWK (CV-63) during May of 1983. The seeker head of the missile was live, providing the pilot with a growling tone in his headset when the missile seeker is locked onto a target. (U.S. Navy)

This F-14 chin pod contains a Northrop Television Camera Set (TCS), which enables Tomcat crews to identify targets at far beyond visual range. The TCS pod has been installed in production Tomcats since 1983 and has been retrofitted to a number of older F-14s. (Author)

He was flying on one of those days when there was a fairly low ceiling, poor visibility, and an obscured horizon over the water. Bill had flown out over the bay and apparently became disoriented while looking in the cockpit to trick that switch. He flew into the water. The cost of this crash to the program was immeasurable, mostly because of the loss of Bill Miller, but also because the aircraft was heavily instrumented for our tests. It was the only aircraft we had instrumented for carrier suit at the time. The situation was sensitive and we had to recover the aircraft to prove what had happened, although there was absolutely no doubt in my mind what we would find.

As soon as we concluded the accident investigation, we progressed immediately to NPE-2 for a look at the discrepancy corrections from NPE-1 and we significantly expanded the flight envelope. I really had the opportunity to look at the F-14 as a fighter in the typical ACM environment. During this evaluation as we were able to complete the carrier suit evals and delve into the flying qualities and performance side of the house. My technical analysis was... "OUT OF SIGHT!!" My objective analysis... "FAR OUT!!!"

I hauled that aircraft through a series of over-heads, high-G turns and slow speed maneuvers that would have departed and spit out anything else in the air. I flew her straight up until she hit zero and backed down and then did it all over again. I had achieved total confidence in this machine with a minimal amount of experience and felt like I had put her on like a tight fitting flight suit, rather than stepped in and sat down. Do I sound like a Tomcat Advocate? Well, I have had ample justification and opportunity to become one. There is no aircraft better for the multiple mission. In fact, there are none that even come close! I want to elaborate on that, but first let me cover one subject that I consider to be very important.

We didn't anticipate an active spin problem and the Grumman approach to analysis was that of spin prevention, rather than spin recovery investigation. Chuck Sewell, Chief Test Pilot for Grumman, had the number two aircraft specifically instrumented and equipped for his spin program. The aircraft had a large spin chute, a hydrozine APU for engine restart, and canards fitted alongside the nose. Chuck was a wizard in the flight test game and honored for his accomplishments in the F-14 program. We lost the advanced analysis of the spin testing when a hyrozine leak atomized and caught fire during flight. Chuck brought her home, but the bird received strike damage and was not to fly again. As a result of his tests, however, a spin prevention device was developed for the aircraft that took conventional lateral control surfaces out of pilot control and shifted roll to rudders in response to stick input at high alpha. An interesting approach that we are still evaluating.

We have lost three aircraft to spins, but two were in the test environment and resulted from unusual circumstances that occurred at the outer edge of the envelope. The third is still under investigation. NASA testing indicated that the F-14 would spin only in the flat mode and would be irrecoverable once the spin was established, but also that a significant effort and failure to apply proper departure recovery techniques would be required to spin the bird. We consider the spins to date to be isolated and do not consider loss of control and spin to be an operational problem.

The F-14 began life as a tremendous concept. Grumman had done their homework during their participation in the F-111 program. So when the time came for the F-14 competitive bids, they were ready. We were pushing the state of the art in a lot of areas...the fan engines for a fighter, with afterburner...the variable geometry wing...the newest concepts in controls and displays...and a subject on which I have not commented: the unparalleled AWG-9 weapons system and Phoenix missile. The most controversial of these had been the engines, both from the higher thrust and better fuel specifics features. We really had some initial problems with our TF-30-P412 engines, but they have been corrected and our confidence level restored. Just as the failure to incorporate new engines as scheduled resulted from a failure of those in power on the hill to recognize our requirements, most other problems with the aircraft were a result of the push for fleet introduction and a shortfall of funding. We still operate on a shoe-string with insufficient parts to repair our machines. But, that's another story.

When everything is said and done, I am extremely excited about the F-14. The weapons system that we have in it is superb. We can do things with the F-14, in a force defense environment, that you couldn't do with a dozen F-4s. I feel when I'm up there that I have the entire picture. The radar capability is just fantastic and the weapons that we carry allow us to engage from eighty miles out, right down to within gun range. The thought that went into designing the aircraft, not just as an interceptor, but as a total fighter was really just fantastic! The ultimate catalyst that makes this aircraft superior to the air superiority fighters currently in vogue is the two man concept. The NFO is the most valuable asset that Navy tactical aviation has today. In the intercept role, he is a dedicated weapons system operator. In the ACM role, he is another set of eyes...another skilled tactician and a superb protective device. I am completely sold on the Tomcat and am looking forward to a long and rewarding relationship with the aircraft."

Emory Brown went on to command Fighter Squadron Eighty-Four (VF-84) before retiring from the Navy.

GENE TUCKER

Between tours in Vietnam, Captain Gene Tucker, USN (ret) was assigned to the Naval Air Test Center (NATC) at Naval Air Station Patuxent River, Maryland. While there, he played an important role in the early testing of the F-14. I interviewed him during 1989. His recollections of events nearly eighteen years previous were remarkably fresh:

"My first involvement with the F-14 was during 1971, while I was assigned to NATC. I was an F-4 pilot and, as such, knew that I would check out in the Tomcat and do the initial carrier suitability testing once we got the aircraft. Since the F-14 is a big aircraft, I was checked out in the RA-5C Vigilante before we got the Tomcat. The idea was to get me used to operating a larger aircraft. The Vigilante was a hard aircraft to fly, so this was a very good experience, particularly in preparation for flying the F-14.

During 1971, I was heavily involved with drawing up test plans with the engineers in preparation for getting the Tomcat. Much of this planning had to do with developmental work on the auto throttles/approach power compensator (APC). As a matter of fact, before we flew the aircraft, we felt that the auto throttles would not be as responsive as they ought to be and made several changes to the computer software. This was as a result of flying the simulator at the NASA/Ames Flight Test Laboratory in California. We spent a lot of time commuting between Grumman at Bethpage, Long Island, NATC, and Ames and when it came time to do the Navy Preliminary Evaluation (NPE), we thought we had developed a pretty good test plan.

Six pilots, two each from Carrier Suitability, Flight Test and Service Test went to Grumman during December of 1971 to begin the first phase of testing. We were restricted to flying the number two aircraft because, unfortunately, the number one aircraft had crashed on its second flight. Number two was a "stiff wing" Tomcat...that is, it had no wing sweep mechanism installed and all flights were made with the wings in the full forward (22 degrees sweep) position (sweep mechanism was eventually fitted to this aircraft). We ran this aircraft through a very extensive slow-speed test program, extending some of the test flights through the use of an A-6 tanker. I believe I did the first Navy in-flight refueling of the Tomcat and am happy to say that I didn't miss on my first try! We did a lot of work in the approach-to-stall regime and in the landing pattern, testing the APC. This work resulted in some interesting events.

During one of the test flights, in which split throttle positions were selected, when the APC was engaged the computer shut down the left engine! The test program was state-of-the-art for that period, which included a hot mike that recorded anything the pilot or RIO said, and computer data links for real-time transmission of test instrument readings. During each test flight there were a host of engineers sitting on the ground, watching the telemetry data and listening to every cough, grunt, or wheeze from the cockpit. In spite of that, I was a third of the way through the single-engine approach before any of the engineers on the ground noticed that I had lost an engine. Naturally, I had seen what happened immediately because it got a whole lot quieter in the aircraft and a whole bunch of warning lights were staring me in the face.

XF 32, an F-14A (BuNo 158621) of VX-4 on the ramp at NAS Point Mugu, California during July of 1973. VX-4 has the mission of evaluating air-to-air weaponry, including that used on the Tomcat. (Peter Mancus via Jerry Geer)

A Tomcat is refueled by a purple shirt (fuels crew) on the flight deck of USS SARATOGA during Mediterranean operations in the Spring of 1986. The ground single point fueling point is just below the inflight refueling probe. (U.S. Navy)

The refueling probe of an F-14 engages the basket of a drogue extended from a KA-6D Intruder tanker. The F-14 carries 16,200 pounds of fuel internally and can carry another 3,800 pounds in two external tanks. (U.S. Navy by Robert L. Lawson)

It was pretty obvious what had happened and the aircraft responded with a very comfortable single-engine approach and landing. The problem was a combination of mis-rigging in both engines and auto throttles (the auto throttles are not supposed to be able to shut down the engines) which we quickly rectified.

On another flight, I experienced an anti-skid failure at a fairly slow speed...probably about 40 knots...and blew both main mounts. Anti-skid is supposed to prevent this sort of thing, while allowing you to stand on the brakes as hard as you can as soon as you land. This gave me the dubious distinction of being the first guy to blow both main mounts in the F-14 and generated the award of a plaque that depicted a Tomcat on crutches with both feet in a cast! (Test pilots don't pass up a chance to insert the needle in a fellow pilot, no matter whose fault the accident is!)

In spite of the fact that the loss of the number one aircraft had curtailed some of our test program, we felt very good about the F-14 at the completion of our initial testing. The aircraft performed very nicely on the glide slope, although you did have to move the nose at the same time you made power changes in order to maintain the proper angle of attack. This as opposed to the F-4, which is about the only aircraft I have ever flown which behaves "according to the book"...that is, airspeed is controlled by attitude and altitude is controlled by power. That is true in all aircraft, but it is usually true in all aircraft some three to eleven seconds after you do it, while in the Phantom it is true almost immediately. In the F-14 we could control it using the APC and the Direct Lift Control (DLC), which was a new feature that employed wing spoilers to dump lift as required.

On one of my last test flights, I was given permission to demonstrate a maximum performance takeoff for the Grumman employees, many of whom had never seen the aircraft fly. I took on an additional 1,000 pounds of fuel before leaving the ramp. On the end of the runway, I quickly advanced the throttles to full afterburner, rotated at 125 knots and kept the nose coming up to maintain 125 knots. This resulted in an eighty degree climb, topping out at 9,000 feet. I hadn't used half the runway and rolled over the top in the middle of the airport. I understand it was a fairly impressive maneuver from the ground...I know it was impressive from the cockpit!

We finished the NPE in December of 1971 and published our report during early 1972. There were a lot of things that we complained about, but that is typical for all new aircraft. One of things I felt very badly about at the time...and still do...is that the F-14 took some unnecessarily bad hits from the press. There were two primary causes of this negative press. The first, of course, was the crash of the number one prototype. Naturally, that put the accident rate right out of sight. Tied to that was the fact that the cost of the aircraft was considered exhorbitant by the public and the congress. Once again, there are not too many new aircraft which are not considered too expensive when they are first introduced. People tend to compare apples to oranges in these cases.

The new aircraft are more advanced and new technology is costly to develop. Then too, they look at the cost of older aircraft in terms of what they cost to manufacture when new. There were a lot of comparisons done with the F-4, using 1962 production figures. They never bothered to use the then current cost of the F-4, which was still in production at that time. All of this was because of the generally anti-war, anti-military mindset of the press and much of the public during 1972.

A flight deck director guides an F-14 onto the starboard catapult aboard USS SARATOGA during operations in the Mediterranean Sea during March of 1986. (U.S. Navy)

There were other problems. Grumman said that the F-14 wouldn't spin. Unfortunately, it not only would spin, but it also had a flat spin mode, which is all but unrecoverable. There were problems with the TF-30 engines. When the aircraft yawed excessively...and I use the term advisedly, since a fighter pilot would not consider the Tomcat's "excessive" yaw as excessive in terms of his normal bag of tricks...the outboard engine airflow would be blanketed out, resulting in a flameout and a possible departure. If the pilot let this departure go long enough and I am not talking a long time here...maybe two or three seconds...the F-14 would get into a self-sustaining flat spin.

It took a long time for us to figure this out, because the negative G induced in a flat spin made it extremely difficult for the crew to position themselves for ejection and get out of the aircraft. During one of these flat spins, the negative G will be anywhere from 3 to 6, which hangs you in your straps and makes it almost impossible to reach either the ejection handles or the flight controls. If you don't get out of the aircraft within the first couple of turns of a flat spin, you are probably not going to get out. The test pilots who induced negative G spins and came back to tell about it, lived with red eyeballs for weeks afterwards.

There were additional problems with the engines, and Pratt & Whitney just refused to believe the engine was as bad as it was. This resulted in an ongoing battle between the Navy and Pratt & Whitney. Every time the Navy complained to Congress about the trouble-plagued TF-30, Pratt would say: "We have found the problem and solved it." In fact, they had not solved it; they only restricted and limited the power of the engine. We probably lost as many as ten F-14s before someone got one back aboard ship after an engine had exploded. Most of the time when that happens, the explosion is enough to start a fire that destroys the whole aircraft.

They discovered that the engines were coming apart in the compressor section, throwing pieces of engine around like shrapnel. The fix was to build a shroud around the compressor sections, so that when the engine exploded it would not destroy the whole aircraft. They hadn't really fixed the engine, they just protected the aircraft from the engines!

Operationally, this caused more problems. It added weight to the aircraft, and initial thrust was reduced. There were severe restrictions placed on the aircraft with regard to how much rudder you could use and what kind of angle of attack you could sustain. In combat you want to be able to fly the aircraft right to the limit...where either your body can't stand anymore or the wings are going to come off the aircraft. In the F-14, you were restricted by engine performance.

I left Pax River shortly after completion of the NPE. Five out of the six NPE pilots were still going to be working on the F-14, which I figured was better than the Navy average, so I talked my way out of there and back to combat. Had I stayed at Pax River, I would have gone on to a new F-14 squadron, which would have meant at least eighteen months of training before the first deployment. I didn't want to do that. Not because I didn't like the F-14, but because I wanted to get back to operating in the fleet...flying off the boat and fighting the war while it was still going on.

My next F-14 experience was when I took command of Fighter Wing One at Oceana. That put me in command of all East coast Tomcat squadrons. The notable events of my tour in Fighter Wing One were the Libyan engagement, in which two F-14s shot down two Su-22s and the decommissioning of the last regular Navy Phantom squadron, VF-171. I flew the F-14 again and discovered that improvements to the engine had continued, although we were still living with significant restrictions.

You could not snap the throttles from idle to military power, or from idle through mil to afterburner. But they had made changes and the APC was really good, which reduced the accident rate for aircraft coming aboard. The weapons system had continued to be improved, so that it was a fantastic system. It encouraged planners to start thinking about using the aircraft in the dogfight mode as well as the long-range intercept role.

This F-14A Tomcat of VF-103 is armed with Sidewinder and Sparrow air-to-air missiles on the wing pylons. The Tomcat is about to be launched from the port catapult aboard USS SARATOGA. The maximum takeoff weight for the F-14 is 74,349 pounds. (U.S. Navy)

A plane director signals a plane captain in the cockpit of a Tomcat to prepare to be towed. The plane captain has his hands in plain sight to assure the deck crew that he will not accidentally engage any systems. The Tomcat was aboard USS KITTY HAWK during August of 1979 for Exercise Fortress Gale. (U.S. Navy)

A lot of this utilization was encouraged by the coming-of-age of the Tactical Air Combat Training System (TACTS), which incorporated several ranges and allowed us to engage in daily air combat against dissimilar aircraft. Afterward we could go back, sit down in the briefing room and look at the computer generated data which told us exactly who had won and who had lost...and why. As simulators became more sophisticated, our training had improved and we discovered that the F-14 is capable of performing all the fighter missions, from long range intercept to air superiority dogfights.

The engine problems have not gone away. We continue to lose aircraft occasionally because of assymetric burner lights or flame outs, but the bottom line is that training has reduced these greatly and, when the new engines are installed, that should finally resolve the engine problem."

This F-14 is ready for launch on the port catapult aboard USS AMERICA (CV-66) in the Med during January of 1984. The nose tow bar is in place in the catapult shuttle and the hold back cable is in position. (U.S. Navy)

FREDERICK HAUCK

Rick Hauck's aviation and scientific credentials are extensive and impressive. He received his BS in Physics from Tufts University during 1962 and his Masters in Nuclear Engineering from MIT during 1966. In between these academic milestones, Rick spent two years in the "Black Shoe" Navy, aboard a destroyer, then went to the Navy Post Graduate School in Monterey, California.

He earned his wings at Pensacola during 1968 and flew a total of 114 combat missions in Southeast Asia from the USS CORAL SEA Sea as an A-6 Intruder pilot with VA-35. He was then selected for training as a test pilot at the Naval Test Pilot School. During his three year tour at the Naval Air Test Center, NAS Patuxent River, Maryland, he served as project test pilot for automatic carrier landing systems for the A-6 Intruder, A-7 Corsair II, F-4 Phantom II, and F-14 Tomcat.

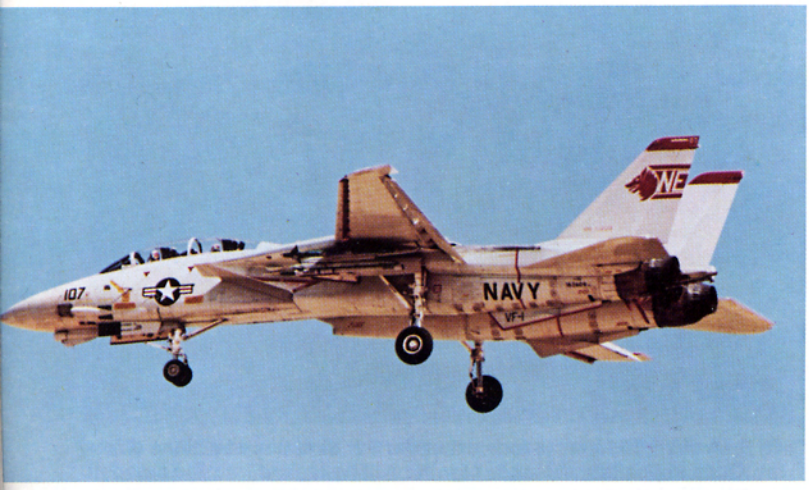
He qualified as an astronaut during August of 1979 and worked as project test pilot for development of night landing aids and techniques for use on the Space Shuttle. He was the pilot of STS-7, which flew in June of 1983 and commanded Shuttle Discovery on Mission 51-A in November of 1984. He also commanded what may be America's most important Shuttle mission, the return to space of Discovery, two years after the loss of Challenger and its crew of seven during January of 1986. While at Patuxent River, he was one of the primary test pilots on the F-14. His recollections of some of that test program follow:

"When Gene Tucker left the F-14 program, after the first Navy Preliminary Evaluation (NPE), CDR Bob Johnson, who was head of Carrier Suitability at NATC, called me into his office. He asked my opinion of the fighter pilots in my graduating class from Test Pilot School, since he needed someone to take Gene's place. I said; "What's wrong with a good A-6 pilot?" Well, he wanted to think about that a little and talk to some other people, but I got the job, which was a little unsual.

There was another obstacle to my taking the job. The Test Pilot School had requested me as an instructor, which was a nice compliment, but not what I wanted to do, since it would mean just one year of testing, then assignment back to TPS. I asked them to reconsider, since I really wanted to spend more time than that as a test pilot. They finally did get someone else to fill that instructor's position and I joined the F-14 NPE team.

Emory Brown and I were the Navy carrier suitability pilots on the F-14 and we flew the second NPE at the Grumman flight test center at Calverton, Long Island. Kurt Schroeder had taken over the reins from Charlie Brown as the contractor demo pilot after Charlie fractured a vetebrae doing a high sink rate (25 feet per second) landing at Pax River.

Myrt Pellegrin and I were project test pilots for the Board of Inspection and Survey (BIS) trials conducted aboard FORRESTAL. One of our tasks was to establish the minimum end airspeed for launch on the F-14. We had to find out how slow we could launch the F-14 before it became dangerous. These tests are run exclusively by Navy pilots, as opposed to having contractor pilot participation), including the shore-based workups. The tests are divided between lightweight and heavyweight aircraft configurations. I flew the heavy tests, which had the launch weight at 64,500 lbs. The load consisted of full drop tanks and



An F-14A Tomcat (BuNo 162609) of VF-1 lands at NAS Miramar, California, on 24 March 1988. VF-1 was the first Tomcat squadron. (Ted Carlson)

A number of F-14s were camouflaged in experimental water based paint for the RAM-86 exercise. This Tomcat, carrying one of the experimental schemes, takes on fuel from a USAF KC-10 Extender. (USAF)

The Catapult Officer gives engine run-up signal to a Tomcat pilot prior to launch. When the engines are at military power, the pilot will salute the Cat Officer, indicating he is ready for launch. The Cat Officer kneels, touches the deck, and the deck edge catapult crewman fires the steam catapult. The 50,000 pound Tomcat is off the deck in less than 250 feet.

This F-14A Tomcat of VF-32 is armed with its maximum load of six AIM-54 Phoenix air-to-air missiles. (Grumman)

An F-14A of VF-302 taxies forward to catapult aboard USS RANGER (CV-61) during Reserve Air Wing Thirty's (CVWR-30) at-sea annual training cruise during 1986. (Robert L. Lawson Tailhook Photo Service)

An F-14 of VF-101 inches forward under the direction of a plane director. Once in position the nose tow bar will be locked into the catapult shuttle. VF-101 is the Atlantic Fleet F-14 training squadron based at NAS Oceana, Virginia Beach, Virginia. (Grumman)

multiple Phoenix, Sparrow, and Sidewinder missiles. These tests are very closely monitored by the flight test engineers, with the carrier deck dedicated to nothing else (the S-3 Viking prototype was aboard for its BIS trials at this time).

The way we did this was to estimate what we thought the minimum end airspeed was, based on our shore trials and other aircraft performance characteristics, then launch at fifteen knots above that to safeguard against the unknown. With each succeeding launch, we reduced the speed by three knots until we found the minimum end speed. The reason we do this is because it is beneficial to be able to launch as slow as possible, since it takes a lot of sea area and more of the carrier's fuel to launch at high speed. We were doing the heavy weight trials, which meant we would have to launch, climb out, dump fuel to get down to landing weight, trap, refuel, then taxi up for the next shot. My RIO during these trials was Karl Volland and Karl and I were in for some exciting launches.

Three things can determine the minimum end airspeed of a given aircraft design. One is Minimum Air Speed for Acceptable Flying Qualities (MSAFQ). In some aircraft, you can still fly and accelerate, but, because you are at such a high angle of attack, lateral directional control is very squirrely. I believe the A-4 was one of aircraft that was limited by MSAFQ. In other aircraft, the minimum speed is determined by that speed at which the thrust available does not exceed the thrust required to accelerate, which means that if you don't drop the nose you will never accelerate...and you can't drop the nose coming off the deck of a carrier. The third condition to affect end speed is angle of attack. Some aircraft reach the end of the catapult stroke at less than the optimum angle of attack (AOA) to produce maximum lift. When you reach the end of the catapult shot, you have to rotate the nose to achieve this angle and, while you are transitioning, the aircraft sinks off the bow of the ship. We knew from shore-based tests that the F-14 was in this category.

The F-14 is unique in that it kneels on the cat to attach the nose gear launch tow bar to the catapult shuttle and the wing is actually at a negative lift angle of attack. When the catapult fires, the nose strut compresses and there is a lot of stored energy in that compressed strut. When the aircraft is released from the catapult, there is a fraction of a second when the nose gear is still in contact with the deck, but that is enough for that stored energy to force the nose up to a positive angle of attack.

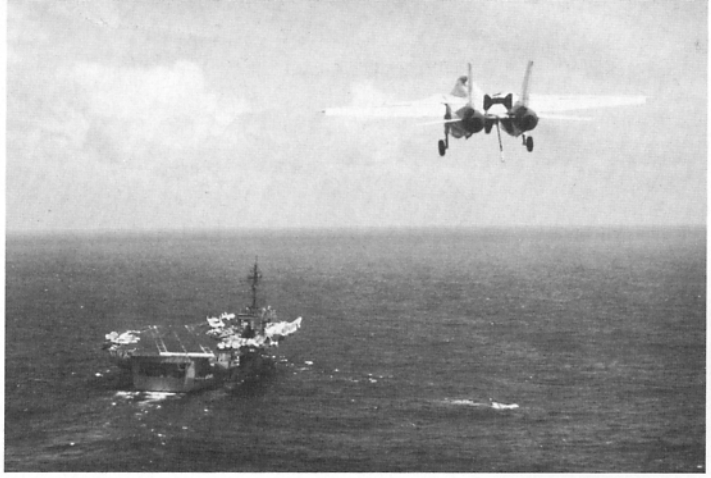
When you start getting closer to the minimum end air speed, you want good, steady wind down the deck. We had a good day and the tests were going well as we approached the minimum. That stored energy, coupled with some judicious use of the stabilators got us transitioned to the proper attitude and we climbed away from the water. On the last launch of the day, I saluted the Cat Officer, he touched the deck, and we were shot down the deck. At that precise moment, the wind dropped off five knots. We reached the end of the cat stroke and sunk right off the bow of the ship, disappearing from the view of the engineers on deck. Karl and I both said; "Holy #$%@!!!...I think we just established the minimum!"*

George Webb, who was the S-3 Project Officer, and I both decided that we needed to fly our aircraft again at night before turning the aircraft over to the fleet. We did some night field carrier landings as a workup for going back out to the boat. Night carrier landings and catapult shots are always more intense. It had been three years since I had been in the fleet, where you are required to maintain a level of currency at night which at least mitigates some of your concern. So three years had elapsed since my last night carrier landing when we went out to the boat to begin our tests.

Our first night cat shot was a "pinky"...the sun was down, but there was still enough after glow to provide some horizon. We launched and climbed out to 20,000 feet to our marshall position behind the ship, then started down for our first carrier-

It is normal for the engine afterburner cans of the Tomcat to be in different positions. Once the hydraulic pressure bleeds off, both nozzles will close down. This Tomcat was assigned to VF-101 aboard USS AMERICA during January of 1984. (U.S. Navy),

F-14As of VF-301 and VF-302 leave the waist and bow catapults of USS ENTERPRISE during CVWR-30's August 1988 carrier qualifications cruise. The F-14 coming off the waist cat has already started a left turn to gain separation from the other Tomcat. (Robert L. Lawson, Tailhook Photo Service)



An F-14A flies the mirror as it makes its final approach for landing. The mirror controls the flight path and angle of attack needed to touch down on the first third of the landing area of the carrier. (Grumman)

The Landing Signal Officer watches as an F-14 of VF-74 engages the number three wire aboard USS SARATOGA in the Mediterranean Sea during March of 1986. A "Three Wire" is the best landing a carrier pilot can make. (U.S. Navy)

controlled approach. It was still a little light when we trapped. On the second one, it was full dark and, although we didn't need afterburner to launch, we agreed that we would make at least one night launch in afterburner. I went to full zone five burner on the launch and, as we cleared the cat, I caught a glimpse of the deck behind us in the mirrors. The glow off the water from those burners was impressive! (I later talked to a CPO on the deck who had come from an F-4 Squadron and was aboard to observe the trials in preparation for his squadron getting the F-14. He said, "I was standing back where I normally would for an F-4 launch and, when you lit zone five burner, the plastic lenses on my goggles melted!")

We turned downwind, remaining at 1,200 feet for a standard carrier "box pattern" for landing. The F-14 had a pitch/yaw computer which translated control stick inputs to the proper movements of the flaperons and differential stabilators. Unfortunately, that computer would periodically blow a circuit breaker and, further unfortunately, it happened on that downwind leg of the landing pattern. It was now a pitch black night, with no horizon when that breaker popped, illuminating a warning light. The breaker panel was down around my left ankle and I had to lean forward and down to reset the breaker. This is a sure-fire recipe for vertigo under these conditions and, although I avoided it, the prospect made that particular night approach more exciting than usual. We did three traps that night and, when I climbed out of the cockpit after the last one, I don't mind telling you that I could hardly walk across the deck...my knees were shaking so bad. It had been a long time between night traps for me and these were the first night cat shots and traps for the F-14. The adrenaline had really been pumping!

The next time we took the F-14 out to the boat, it was to ENTERPRISE. We wanted to do some further testing to define the envelope for wing position and flap settings for carrier landings. VF-1 and VF-2 were also going out to the boat for their initial F-14 carrier qualification period (CARQUALS). Another reason for our tests were to verify the relocation of the inertial navigation system. It had originally been installed in a position in the nose gear wheel well which just happened to get the highest dose of G's on launch, which caused the INS to fail.

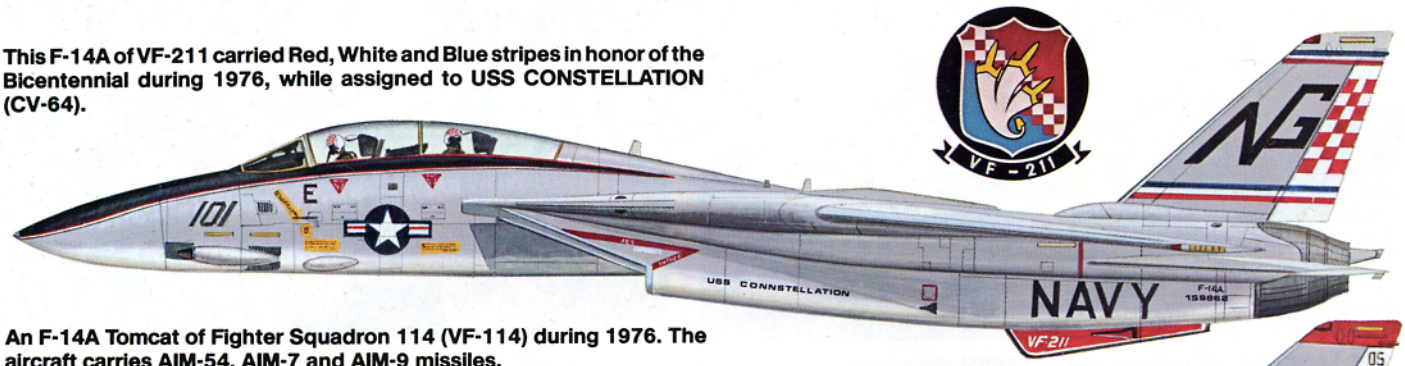
One of the new features on the F-14 which we experimented with extensively was the Direct Lift Control (DLC). The F-14 is a flaperon-equipped aircraft and, unlike ailerons, which can generate lift or kill lift, depending upon whether they are raised or lowered, the flaperon normally can only kill lift. The flaperons are on top of the wing and, when they are raised, they kill lift. But if you rig the flaperon so that it is slightly raised when in neutral, you can achieve instantaneous lift just by lowering them flush with the wing...and I do mean instantaneous!

In a conventional aircraft, you have to increase the angle of attack to achieve added lift and there is always a little lag between the action and the result. Not so with DLC. The advantages of this instant lift reserve during a carrier approach are obvious and we wanted to further define the operational parameters of DLC. We felt that it was well worth the few extra knots of air speed those slightly open flaperons cost for the added vertical response. The F-14 has a thumbwheel on the stick that controls DLC. If you roll the thumbwheel down, the flaperons come up, killing more lift and increasing your sink rate. Roll the thumbwheel up and the flaperons go to the faired position, increasing lift. The plane did not meet Navy specifications with DLC installed, and a lot of people said, "Well, its not that important, lets just get rid of it." But Em Brown disagreed and pushed real hard to retain this added capability. Operationally, I doubt that DLC is used very much, but I agreed with Brown that it should be kept on the aircraft. In order to use DLC effectively, the aircraft needed a good Approach Power Compensator (APC). The first F-14 APC was terrible. Kurt Schroeder and I worked on the new APC and I have to give Kurt the credit for coming up with a good APC configuration.

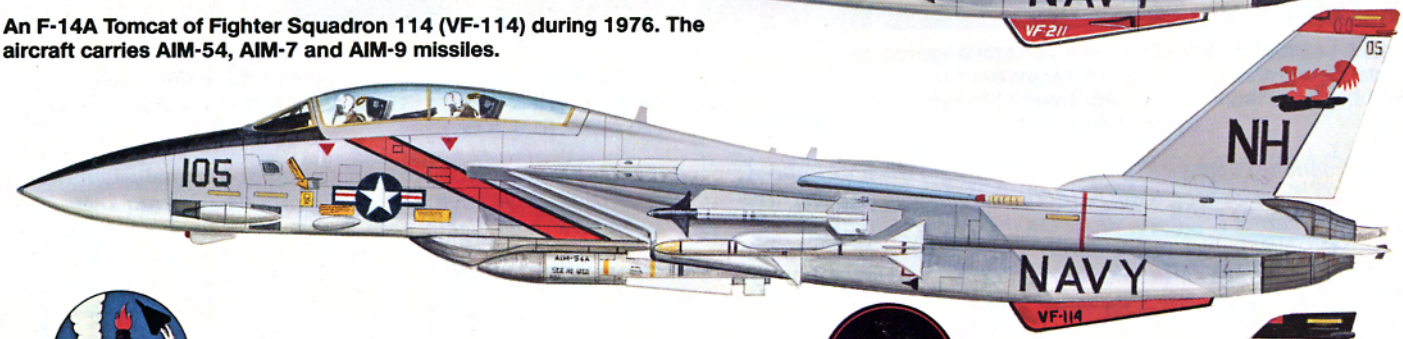
By the time we got to the ship, we had a good APC and we proved DLC was very workable. We were very pleased with the results of our trials on this trip. After I left NATC, I was assigned to Air Wing 14 Staff as Operations Officer, and flew with VF-1 off the ENTERPRISE. I used DLC, but I don't think many others did. It was another training burden and, if you weren't really using it all the time, its value became marginal, but the concept was good and, if you used it all the time, it was very helpful. I made two cruises with the air wing, including the cruise in which we supported the evacuation of Vietnam. I was fortunate to have flown the A-6, A-7 and F-14 at Pax River and was allowed to fly all three during these two cruises, both day and night."

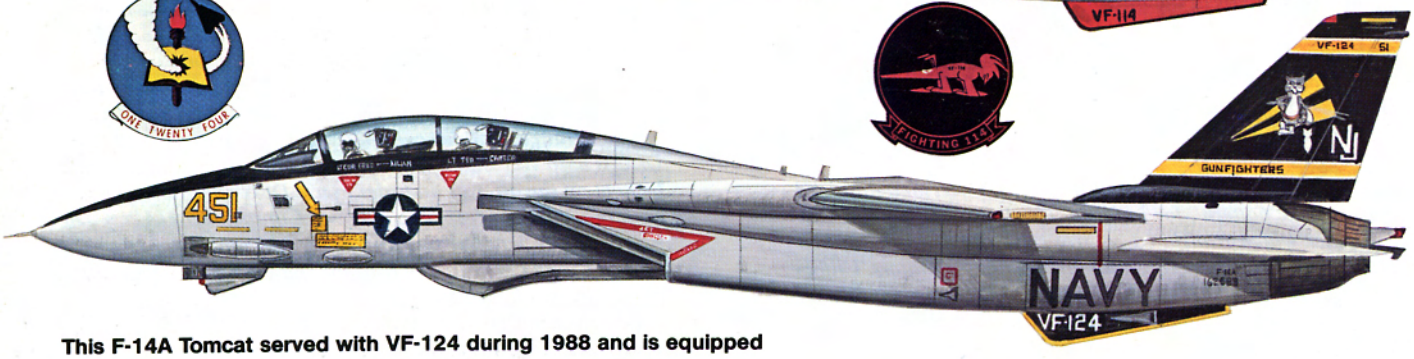
Rick spent eleven years in the Astronaut Office before returning to Washington as Director of Naval Space Systems. His extensive experience in space flight begged the question: how does flying spacecraft compare to flying tactical aircraft? His answer: "Of course, it is all part of the same great adventure, but the space program is a much more structured environment...you hope it is much more predictable...you don't want to have surprises in that business. In tactical flying, surprises and coping with them is what it's all about."

This F-14A of VF-211 carried Red, White and Blue stripes in honor of the Bicentennial during 1976, while assigned to USS CONSTELLATION (CV-64).



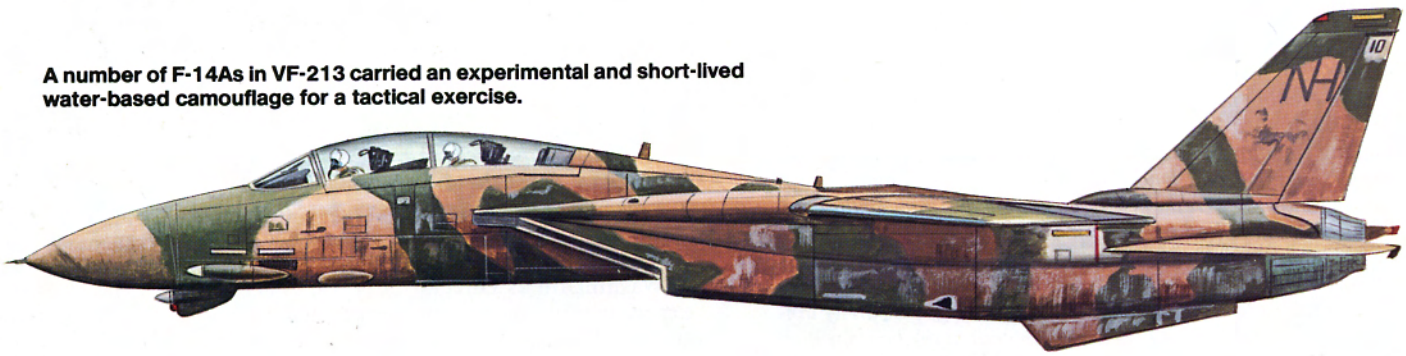
An F-14A Tomcat of Fighter Squadron 114 (VF-114) during 1976. The aircraft carries AIM-54, AIM-7 and AIM-9 missiles.



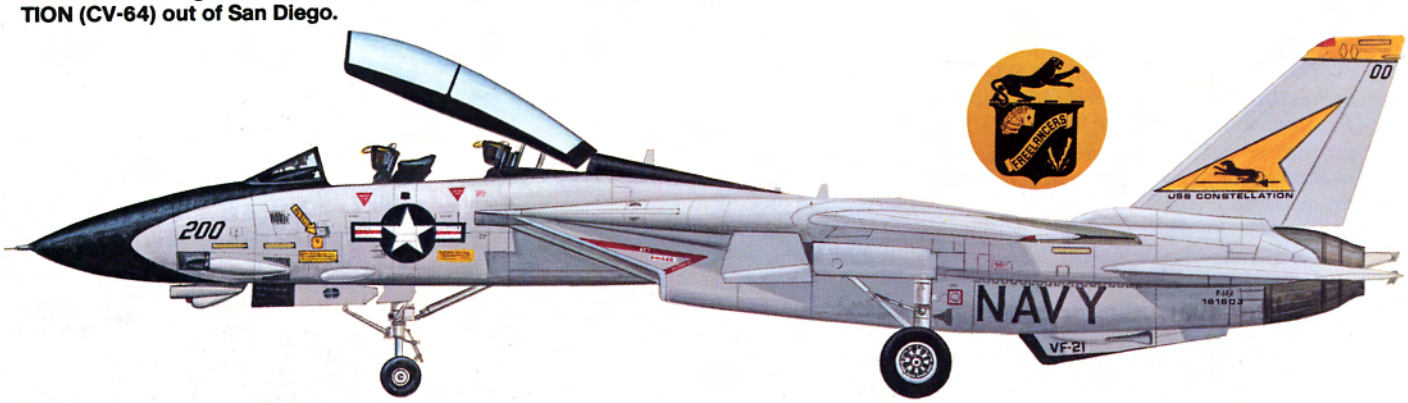


This F-14A Tomcat served with VF-124 during 1988 and is equipped with a TCS chin pod.

A number of F-14As in VF-213 carried an experimental and short-lived water-based camouflage for a tactical exercise.

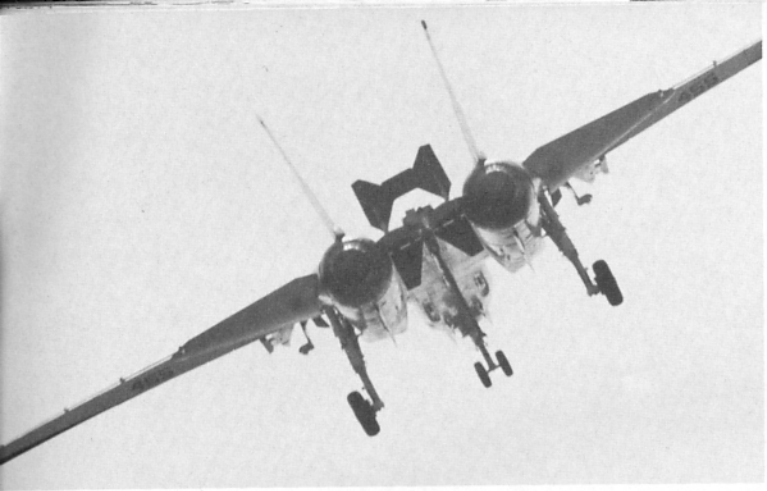


This F-14A is assigned to VF-21 Freelancers aboard USS CONSTELLATION (CV-64) out of San Diego.



An F-14A of VF-111 Sundowners on approach for landing aboard USS KITTY HAWK.

Lou Irrendel '90



AN F-14A of VF-124 turns on final approach at NAS Miramar, California. The upper and lower speed brakes are both deployed at 60 degrees. The speed brakes are used on final approach to keep engine speed up, ensuring a more rapid response in case of a missed approach. (Ted Carlson)

AN F-14A of VF-1 comes aboard USS ENTERPRISE during March of 1974. VF-1 was officially commissioned on 14 October 1972, but did not receive its first aircraft until 1 July 1973. The two aircraft on the deck are Lockheed T-1A (T2V) Sea Star trainers. (U.S. Navy)

This new production F-14A was assigned to VF-1 Wolfpack, one of the first two operational squadrons to receive the Tomcat. At the time VF-1 carried highly colorful squadron markings in Red and White. (U.S. Navy)

An unsafe gear indication dictated that this Tomcat of VF-1 make a barrier landing aboard USS KITTY HAWK on 30 June 1984. After the landing, an NP-50 crane was moved into position to move the crippled Tomcat. (U.S. Navy)

An F-14A of VF-1 Wolfpack intercepts and escorts a pair of Russian Tu-16 Badger F electronic reconnaissance aircraft on 14 July 1987. The Tomcat will remain with the Badgers until they are well clear of the task group. (U.S. Navy)

VF-1's 1984 cruise was made aboard USS KITTY HAWK (CV-63). The squadron conducted its work-ups over the California desert prior to embarking aboard ship for the eight month WESTPAC (Western Pacific) cruise. (Grumman)

During the AIMVAL/ACEVAL missile evaluations held at Nellis AFB, six VF-2 Tomcats were painted in an experimental splinter camouflage scheme. The scheme was not adopted for operational use. (Tailhook Photo Service)

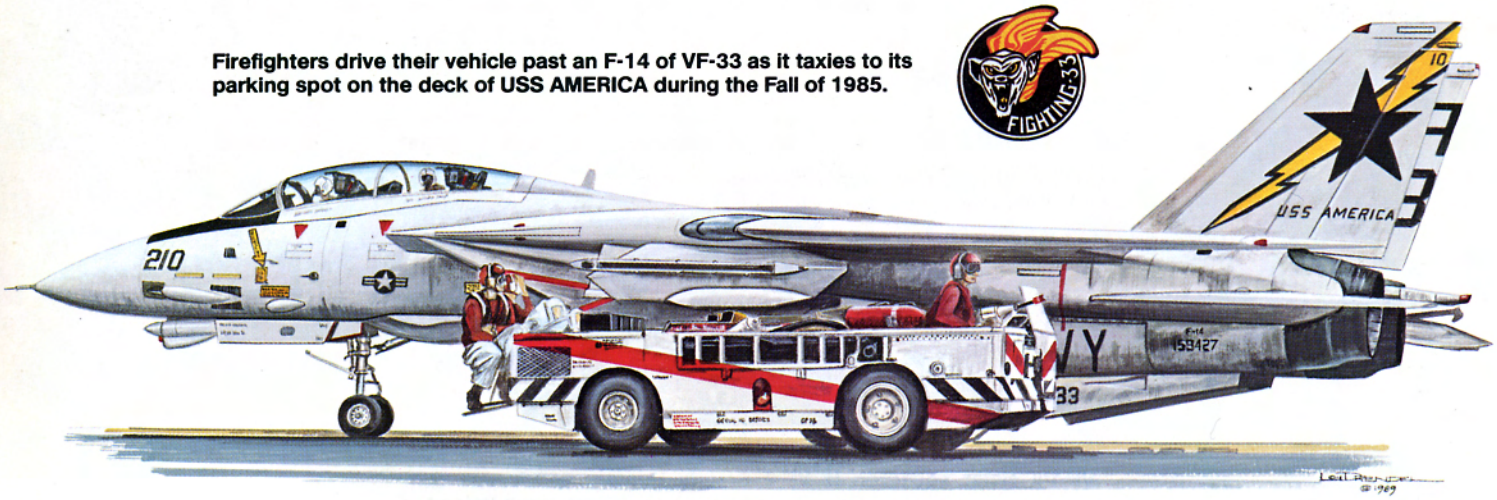
VF-1's sister squadron is VF-2 Bounty Hunters which was commissioned at the same time. Pilots for both squadrons were trained by VF-124, also based at Miramar, California. This VF-2 Tomcat was on the ramp at NAF Andrews on 30 October 1982. (Don Linn via D. F. Brown)

This Tomcat pilot is discussing the preflight inspection with his RIO while manning his Tomcat aboard USS SARATOGA in the Mediterranean during March of 1986. Once the crew are in the aircraft the plane captain will retract the boarding ladder and steps. (U.S. Navy)

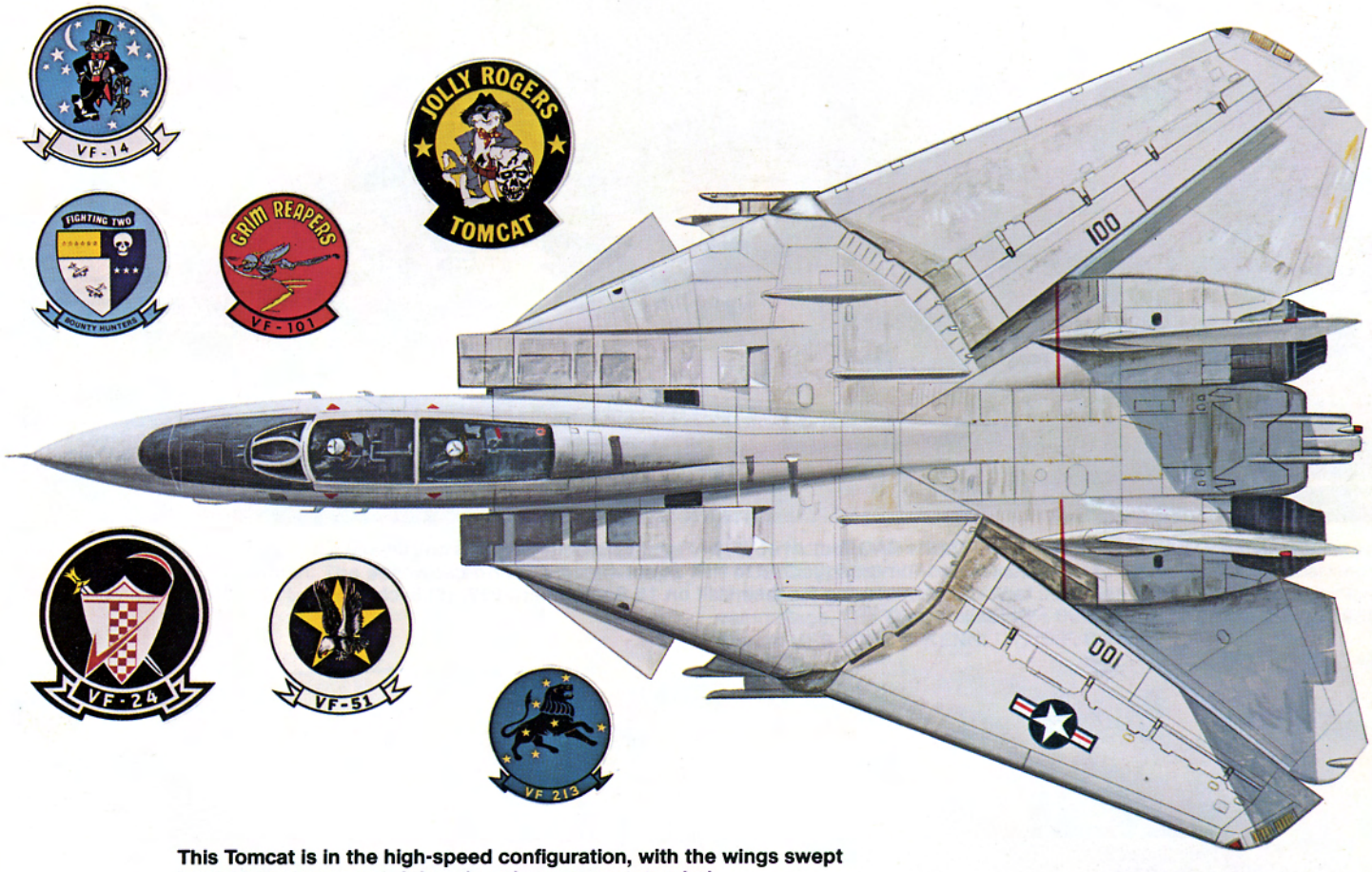
The need for better camouflage led to the disappearance of colorful squadron markings. They were painted on in shades of Dark Gray on overall Dark Gull Gray aircraft. VF-1 made cruises aboard USS RANGER (CV-61) during 1981 and 1982. (Grumman)

When they were first commissioned, VF-1 had one of the most colorful paint schemes ever applied to the Tomcat.

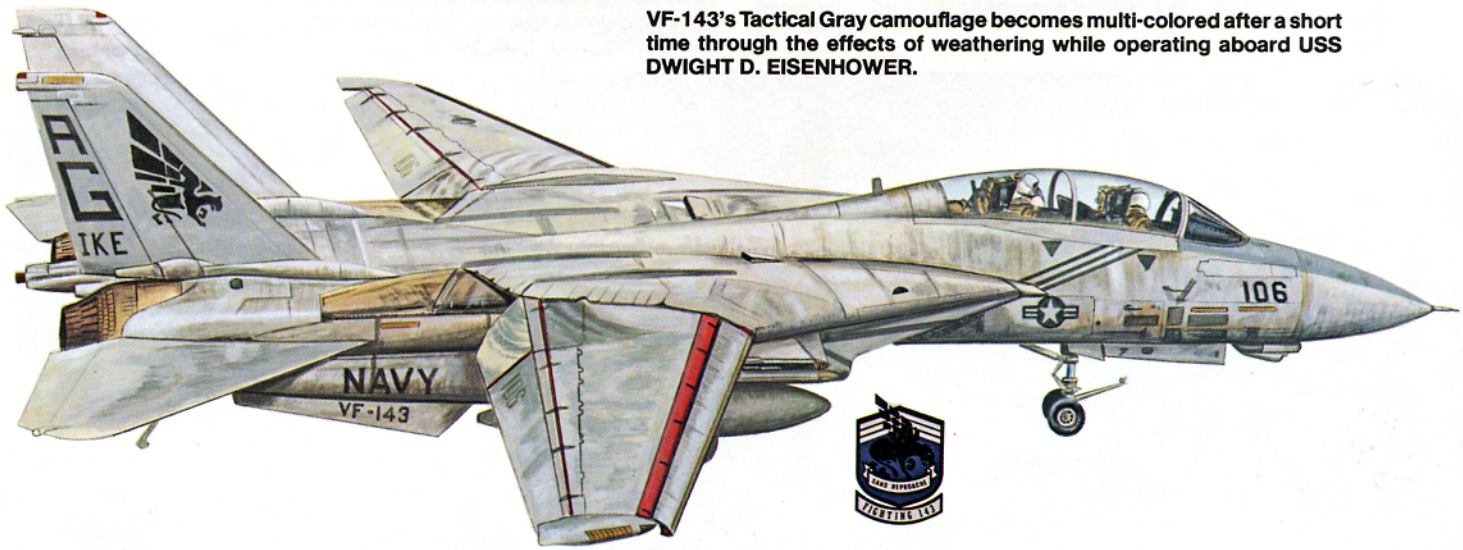
Firefighters drive their vehicle past an F-14 of VF-33 as it taxies to its parking spot on the deck of USS AMERICA during the Fall of 1985.



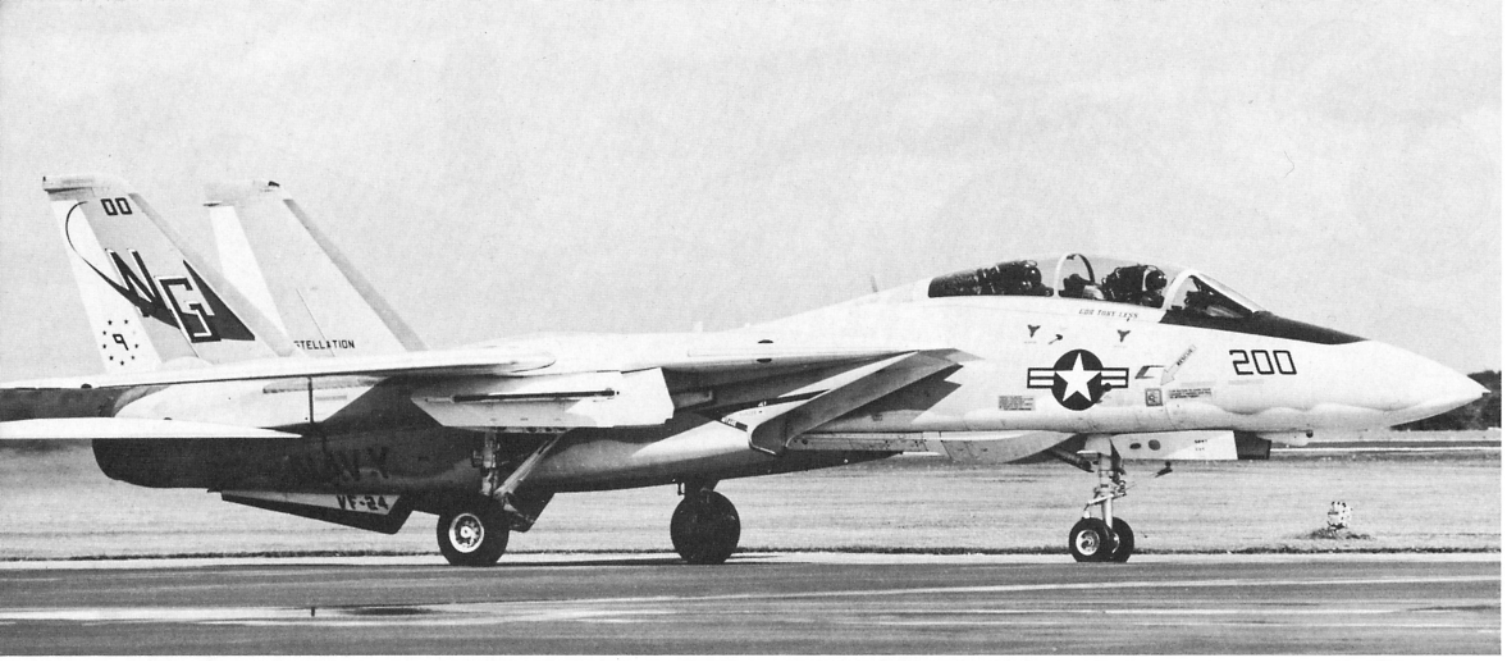
VF-31's mascot, Felix the Cat, has been going to sea aboard USS FORRESTAL for nearly three decades, most recently on the fuselage and vertical fin of the F-14A Tomcat.



This Tomcat is in the high-speed configuration, with the wings swept back at 68 degrees and the wing glove vanes extended.



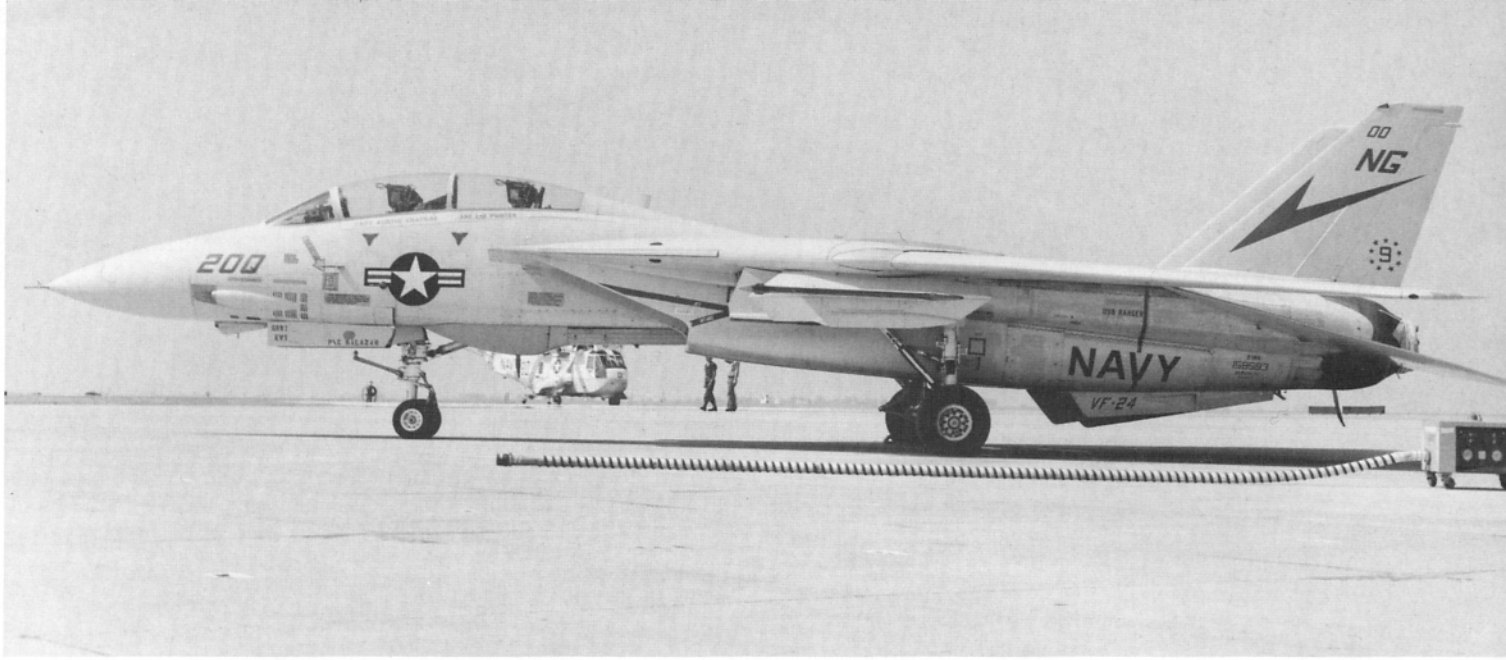
VF-143's Tactical Gray camouflage becomes multi-colored after a short time through the effects of weathering while operating aboard USS DWIGHT D. EISENHOWER.



NG 200 is the CAG Tomcat of VF-24 Fighting Renegades. This unit was the second Tomcat squadron to visit Japan during a 1977 deployment to WESTPAC, arriving for their visit on 15 September 1977. (Shinichi Ohtaki)

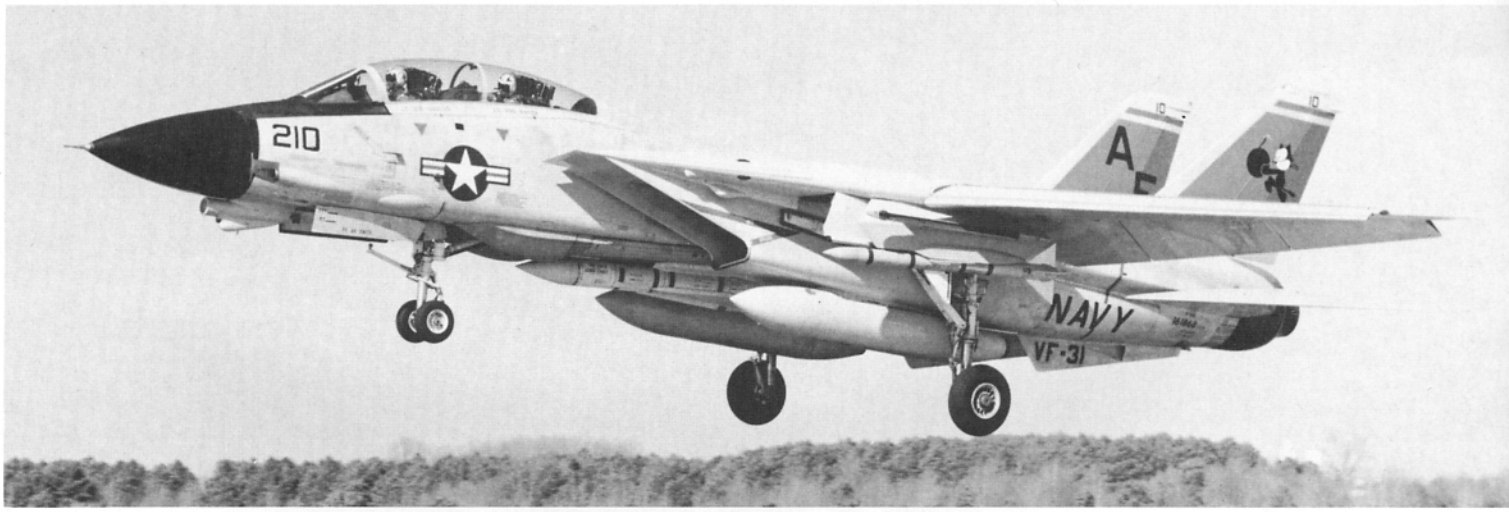
An F-14 of VF-14 Tophatters takes off in full afterburner. VF-14 transitioned to the F-14 during 1974 and made the first Mediterranean cruise for the Tomcat during 1975. (Grumman)

An F-14 of VF-21 Freelancers on the flight deck of USS CONSTELLATION during Fleet Exercise 85. VF-21 was one of the last two regular Navy squadrons to transition to the Tomcat, receiving their first Tomcats during 1984. (U.S. Navy)



(Above) This Tomcat of VF-24 was used by Air Wing Nine Commander (CAG), CAPT Austin Chapman. The aircraft was on the ramp at NAS Miramar on 4 April 1984. (Brian Rogers via D.F. Brown)

(Below) A Tomcat of VF-31 Tomcatters lands at NAS Oceana, Virginia, on 31 January 1989. VF-31 has managed to retain its colorful markings after most other squadrons had transitioned to overall Gray tactical camouflage. The Tomcatters made their first F-14 cruise during 1982 aboard USS JOHN F. KENNEDY. (D.F. Brown)



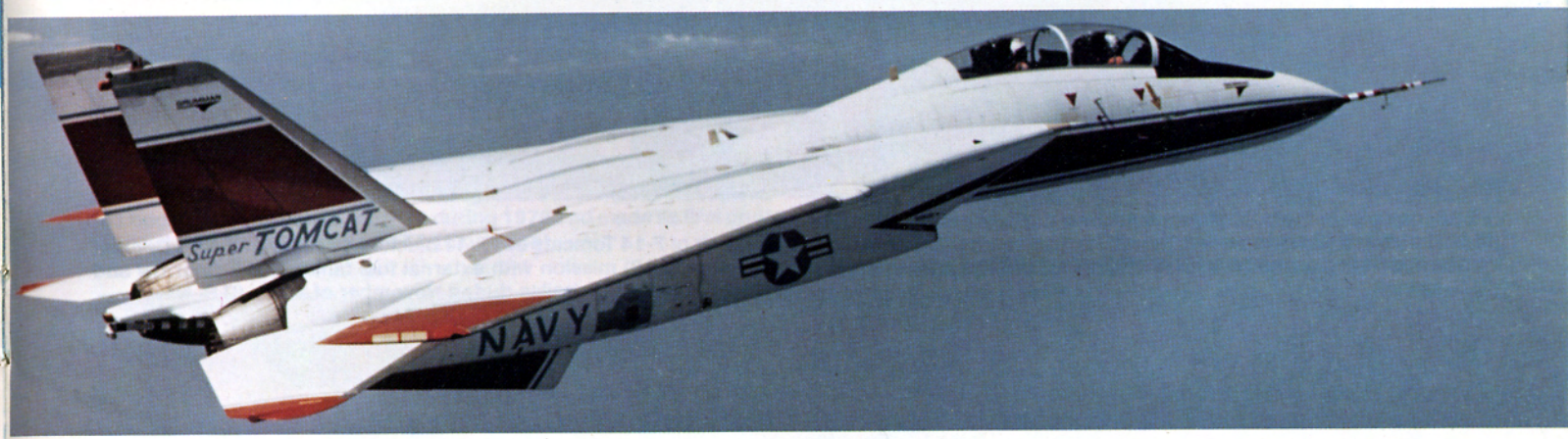
This F-14A (BuNo 159610) of VF-32 was one of two Swordsmen Tomcats to score kills over Libyan MiG-23s in the Gulf of Sidra during January of 1989. VF-32 transitioned to the Tomcat along with VF-14, becoming the first Atlantic Fleet fighter squadrons to fly the F-14. (D.F. Brown)

A VF-51 Tomcat and a Top Gun A-4 Aggressor pass head-on at the beginning of an engagement. The A-4 is used to simulate the MiG-17 at Top Gun.

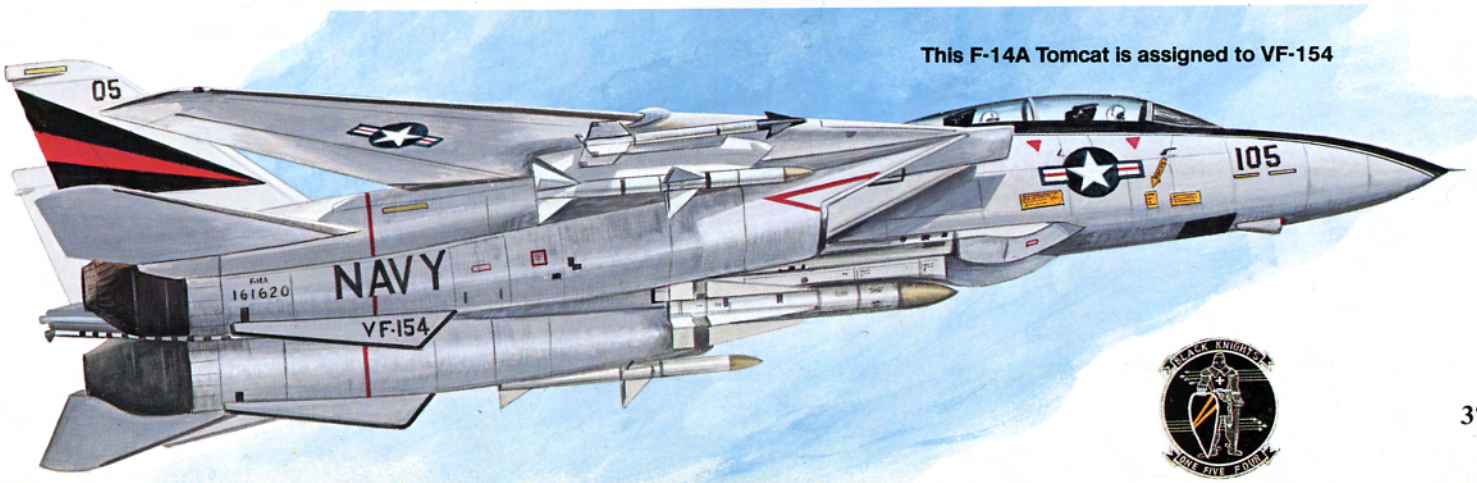
An F-14A of Fighter Squadron Thirty-Two (VF-32) aboard USS INDEPENDENCE. The aircraft carries both the Safety "S" and Battle "E" awards on the vertical fin.

Four F-14As of VF-32 form a diamond formation over the wake of USS JOHN F. KENNEDY prior to entering the landing pattern after a Combat Air Patrol mission. (Grumman)

The F-14B Super Tomcat was the number seven F-14 prototype reconfigured and re-engined with GE-F-101 DFE engines for a test program during 1982. (Grumman)



This F-14A Tomcat is assigned to VF-154



This F-14 of VF-33 taxies to the port bow catapult aboard USS CONSTELLATION on a Sunday afternoon in November 1985, while the ship was conducting flight operations off the coast of Virginia. (Author)

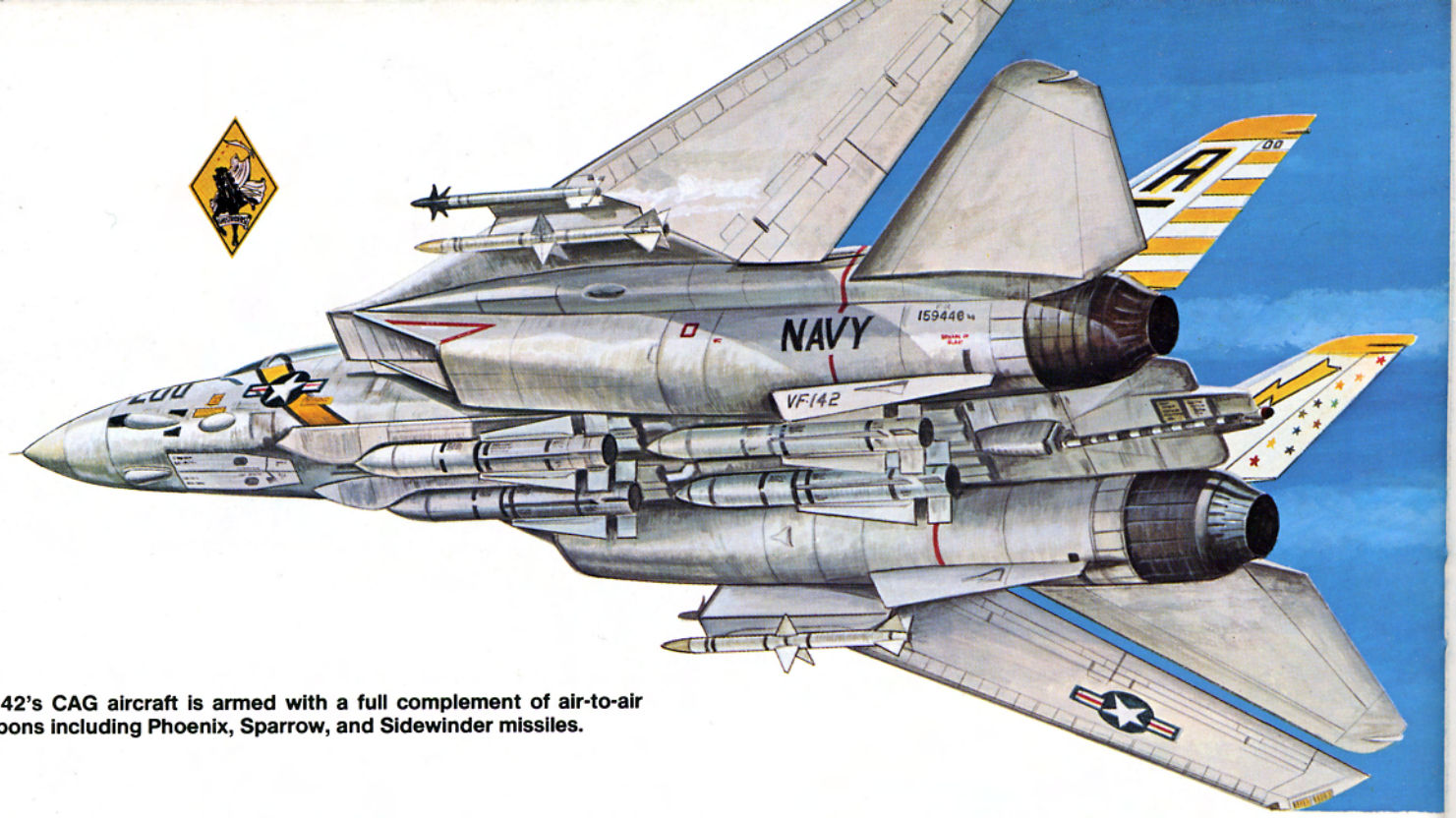
VF-33 took part in the U.S. raid against Libya during April of 1986. This Sidewinder and Sparrow armed Tomcat has the tow bar attached so it can be positioned on the deck of USS CONSTELLATION prior to launch. (U.S. Navy)

This pair of F-14 Tomcats of VF-41 Black Aces are armed for a Combat Air Patrol (CAP) mission with external fuel tanks, AIM-7 Sparrow and AIM-9 Sidewinder missiles during November of 1986. (U.S. Navy)

VF-41 Tomcats carry a Black and White unit marking on the fin. These are a far cry from their earlier markings of a Black ace, Red sash on an all White fin. The carrier name (USS NIMITZ) and air group ID (AJ) are unusually small. (D.F. Brown)

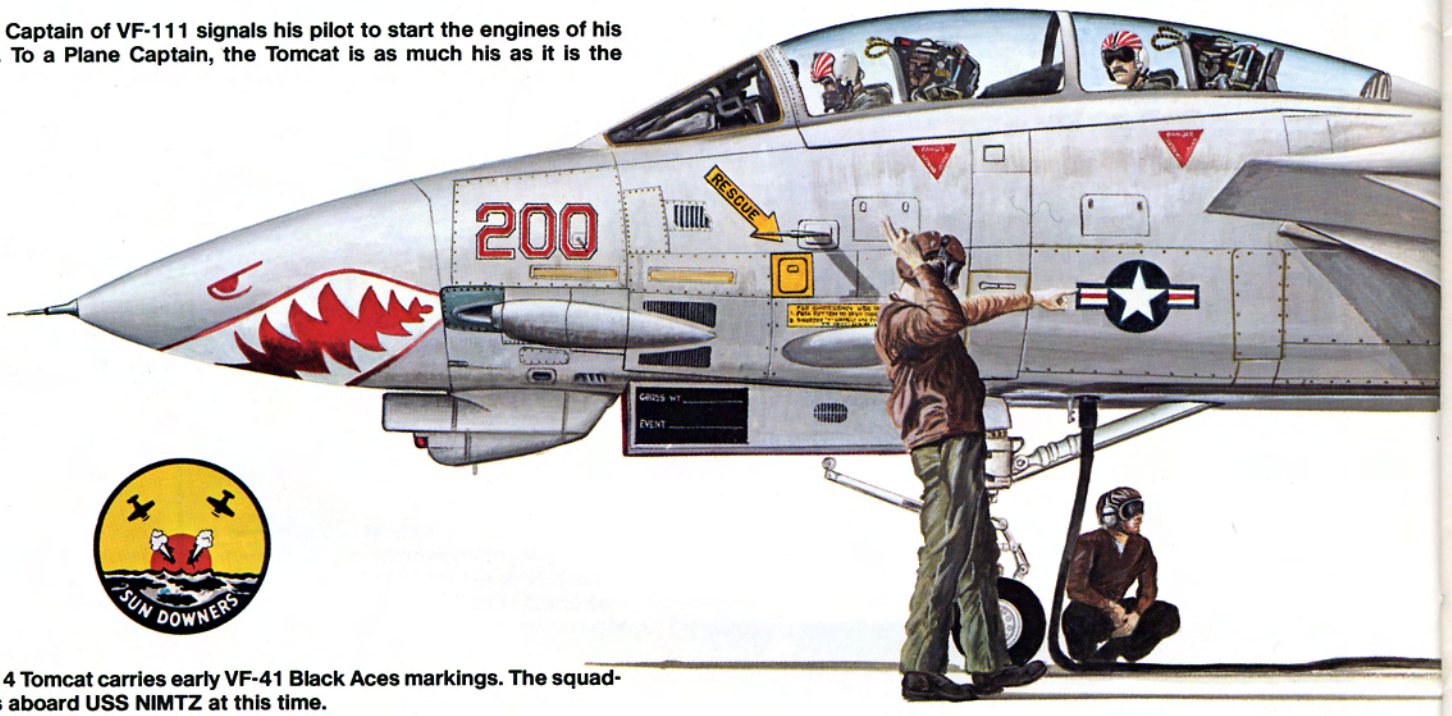
(Above) This F-14 of VF-41 has the wings in the full forward position. VF-41 began its transition to the F-14 during 1976 and made its first cruise aboard USS NIMITZ during 1977. (Grumman)

(Below) A VF-41 Tomcat is positioned on the catapult of USS NIMITZ during flight operations on 17 August 1982. Two days later, a pair of Black Aces F-14s shot down two Libyan Su-22s over the Gulf of Sidra, after the lead Fitter fired an Atoll missile at the Tomcats. (D.F. Brown)

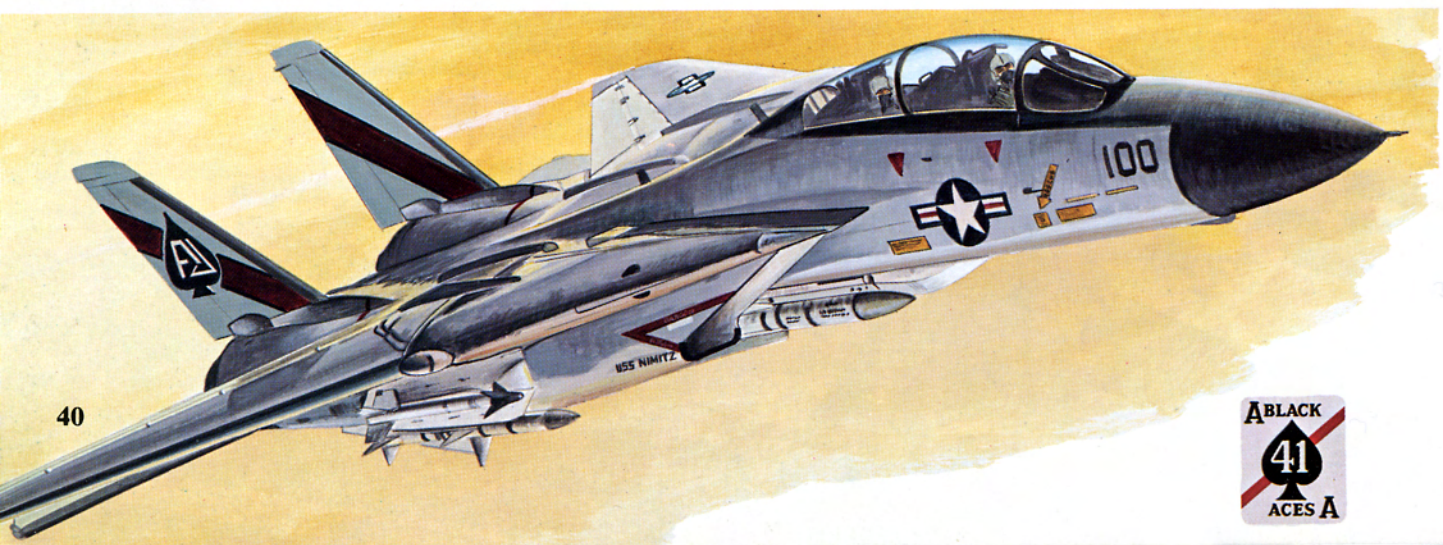


VF-142's CAG aircraft is armed with a full complement of air-to-air weapons including Phoenix, Sparrow, and Sidewinder missiles.

A Plane Captain of VF-111 signals his pilot to start the engines of his Tomcat. To a Plane Captain, the Tomcat is as much his as it is the crew's.



This F-14 Tomcat carries early VF-41 Black Aces markings. The squadron was aboard USS NIMTZ at this time.



A Tomcat of VF-32 tied down on the ramp at NAS Oceana on 31 April 1983. VF-32 TARPS Tomcats provided photo intelligence to the Marines during Operation URGENT FURY, the invasion of Grenada, during October of 1983. They continued their cruise to the Med, where they drew fire from Syrian guns while making photo runs over Lebanon. (D.F. Brown)

A trio of VF-33 Tomcats on the ramp at NAS Fallon for Strike training. The pod on the wing pylon is a missile simulator pod that feeds information back to the ground stations to allow for computer recreation of the mission. (Robert L. Lawson Tailhook Photo Service)

When VF-51 transitioned from the F-4N Phantom II to the Tomcat during 1978 the squadron retained its distinctive Red-striped Black fin and White outline code letters. The Tomcat is in the high speed configuration with the wings back and the wing glove vanes extended. (Grumman)

AN F-14 of VF-51 Screaming Eagles gets the launch signal from the catapult officer aboard USS KITTY HAWK on 21 August 1979. The KITTY HAWK was engaged in flight operations during Exercise Fortress Gale. (U.S. Navy)

Tactical Gray camouflage resulted in VF-51 abandoning the distinctive Black tail markings. NL-103 is landing aboard USS CARL VINSON (CVN-70), the tailhook was about to engage the number two wire (an ok pass). VF-51 was aboard VINSON for its first cruise during March of 1983. (Robert L. Lawson Tailhook Photo Service)

The only compromise to the tactical Gray camouflage on this F-14A of VF-114 embarked aboard USS ENTERPRISE is the AIM-54 on the fuselage underside. The AIM-9 on the wing pylon has also been painted Gray. (USN via Nicholas J. Waters III)

KURT SCHROEDER

...is a native of Wisconsin. He graduated from the University of Wisconsin with a BS in Mechanical Engineering and Naval Science. He was commissioned as an Ensign upon graduation and went to NAS Pensacola for flight training. He spent his initial tours performing the all-weather carrier fighter mission, flying the F-8 Crusader and F-4 Phantom. Following graduation from the U.S. Navy Test Pilot School, Kurt spent three years in the carrier suitability branch at the Naval Air Test Center, flying predominantly F-8 and F-4 projects.

He has been Grumman's Chief Test Pilot since 1986 and has been with the F-14 program since 1972. His is a unique perspective in that he has been in the position of being able to observe, first hand, the progression of the F-14 during its almost twenty year career. He has also initiated many of the changes that have been incorporated into the basic airframe, has tested all modifications to the Tomcat and is currently involved in testing the F-14D Super Tomcat. In addition to his work on the F-14, he also served as X-29 Project Pilot and made the first flight of the forward-swept wing experimental jet.

The initial test program was exhaustive and thorough and I wondered what Schroeder's duties were once the Tomcat went into squadron service.

"The aircraft was in a constant state of development. Even though we didn't make any major changes, there are always problems that come up or additional capabilities that the fleet would like to have incorporated into the aircraft. We spent a lot of time doing liaison with the fleet; then designing, testing, and implementing the changes needed to meet their requirements. As an example, during the mid-70s, fleet aircraft experienced several mishaps involving an audible "Thump-Bang," followed by an aircraft fire and loss of the flight controls. The origin of the problem was isolated to failure of the TF-30 engine fan blades. The failure had been seen once previously on a Navy test aircraft but at the time it was thought to be an isolated case. When several other engines experienced the same failure at approximately the same number of total engine hours, it became obvious that it was a generic problem created by normal operational use of the engine. The kinetic energy of the departing fan blade not only allowed it to go right through the engine case but to continue and rupture an engine fuel line located nearby. Pratt & Whitney successfully modified the engine and Grumman instituted several survivability changes to significantly increase the aircraft's ability to survive in-flight fires.

During the development program, it was determined that the aircraft's maneuvering capability could be significantly enhanced by the installation of improved maneuver devices. Early aircraft incorporated only a ten-degree trailing edge flap capability, commanded manually through a control stick mounted thumbwheel. Efficient use of a manual system during the rapidly changing flight conditions associated with Air Combat Maneuvering (ACM) was difficult and added to the pilot's workload. Consequently, the function was automated as function of angle-of-attack and modified to include leading edge slat extension in addition to the trailing edge flap.

The modified system made its first appearance on the 185th production Tomcat and now has been retrofitted to all F-14s. I know of at least one Navy crew who owe their lives to the change. One of the new aircraft was being utilized in an airshow practice which included an Immelman maneuver on takeoff. Instead of rolling upright at the top, the pilot became disoriented and proceeded to pull the aircraft through in a "Split-S" maneuver from 3,000 feet above the ground. I don't believe an unmodified aircraft would have made it.

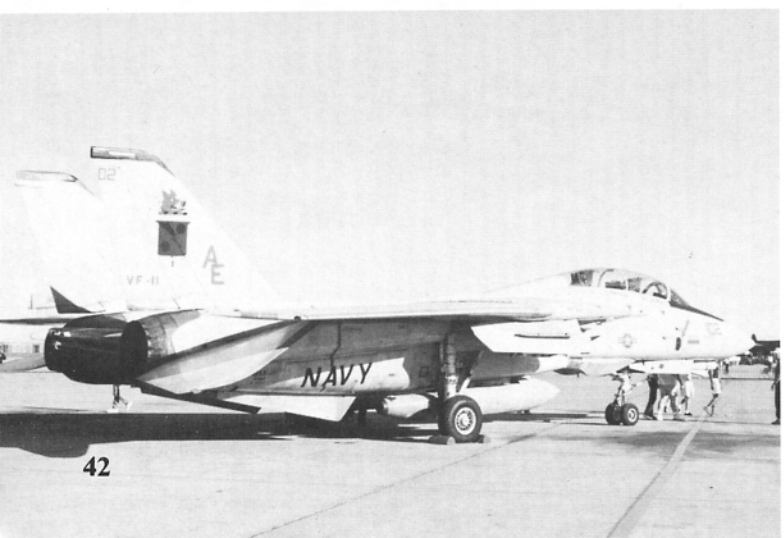
Although there have been a multitude of changes to the aircraft since it was first flown in December of 1970, the first major alteration came with the incorporation of the F-110-GE-400 engines in October of 1986. The viability of the engine had been demonstrated several years earlier during a flight test program performed with General Electric's F101 (Derivative Fighter Engine). After over twenty years of fleet service, the F-14 finally received an engine which produced the thrust levels that the airframe was originally designed for. In addition, the operability of the F-110-GE-400 is outstanding."

The troubles with the original Tomcat engine, the Pratt & Whitney TF-30, were well publicized and led me to ask about their propensity to cause stalls/spins as a result of airflow-induced engine stalls.

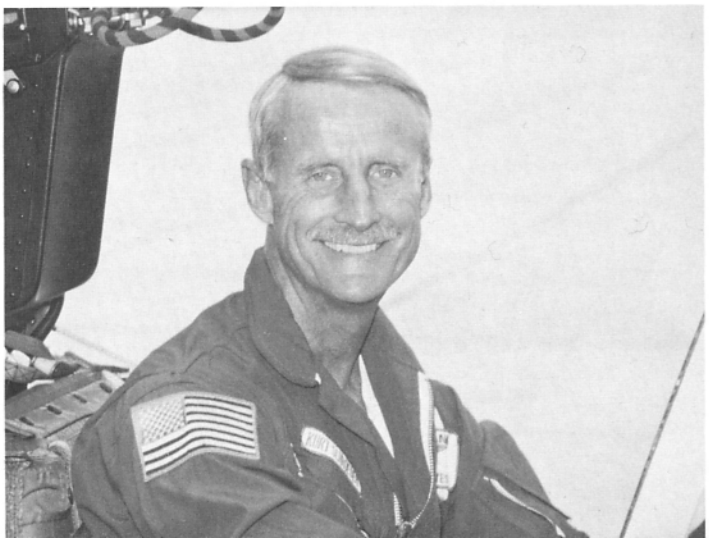
"This characteristic is referred to as the operability or compatibility of the engine. The maneuvering capability of the F-14 throughout a flight envelope which ranges from very low speeds to Mach 2+ provides a severe test of this engine characteristic. Large values of angle-of-attack and sideslip result in disturbed airflow down the engine inlets, producing significant distortion at the compressor face. If the engine control system is unable to compensate for the condition, the compressor blades, much like an aircraft's wing, will stall. Mating an afterburner to a high bypass ratio fan engine, creates additional compatibility challenges because pressure spikes associated with afterburner use can travel up the fan duct and cause the compressor to stall.

An engine stall creates two concerns: an immediate loss of thrust and potential damage to the engine. Damage to the engine results when the engine fuel control senses a deceleration in commanded compressor speed caused by the stall and tries to compensate for it by adding fuel. Without pilot action, the additional fuel combined with the disrupted airflow can quickly

An F-14A (BuNo 161853) side number AE-102, of VF-11 Red Rippers on the ramp at Luke AFB, Arizona on 26 March 1988. The Red Rippers transitioned from the F-4 Phantom to the Tomcat during 1980, joining Air Wing 3 aboard USS JOHN F. KENNEDY. (Ted Carlson)



Grumman Chief Test Pilot Kurt Schroeder. (Grumman)



NL 113 blew both main mounts during a hard landing aboard USS KITTY HAWK on 25 August 1979. VF-51 was making its first Tomcat cruise. (U.S. Navy)

result in damaging turbine inlet temperatures. The loss of thrust produces a yawing moment which is normally easily countered by the aerodynamic stability for the aircraft. The airframe stability, however, varies as a function of airspeed and angle-of-attack and if a large thrust asymmetry exists (i.e. one engine in full afterburner with the other stalled) in an area that the aerodynamic stability is low, thrust will dominate. Without pilot corrective action, the aircraft could be driven into a departure from controlled flight and possibly into a spin.

Proper pilot corrective action would be to reduce the thrust asymmetry and apply flight control inputs to counter the yawing moment. While the aircraft retains very strong recovery control power, even in severe departures, prompt and correct application of the proper controls is difficult for the fleet pilot because of the disorieting nature of departures from controlled flight. Procedures which are easy to apply in a benign environment become much more of a challenge when suddenly subjected to the rapidly changing attitudes and accelerations of uncontrolled flight.

An example of the confidence we have in the recovery capability of the F-14 is a program we flew to evaluate the operability and asymmetrical thrust effects of the F110-GE-400 engine. To accomplish the program objectives, intentional departures from controlled flight were required. While this type of work had been conducted during several programs with the TF-30 powered aircraft, the test aircraft had always been equipped with a spin recovery parachute, deployable spin-recovery forward canards, special pilot escape provisions and an emergency power system for hydraulic and electrical power. The immediate problem was that an F110 powered F-14 equipped with these provisions did not exist and to modify one would require unavailable time and money.

The question was then raised: "Could we conduct the program with essentially an unmodified aircraft?" After many discussions between Grumman and NAVAIR, the decision was made to proceed. Over 300 successful recoveries following the same number of intentional departures confirmed the confidence. Yaw rates of over 70 degrees per second, angles of attack of plus or minus 90 degrees, sideslip angles past the instrumentation display limit of 50 degrees and rates of change of sideslip of 200 degrees per second provided the desired severe test of the F110 engine, and it passed with flying colors. For example, one particularly dynamic departure which routinely stalls and flames out the TF-30 engine, even when stabilized at its best power setting, had absolutely no effect on the F110-GE-400 engine at any power setting.

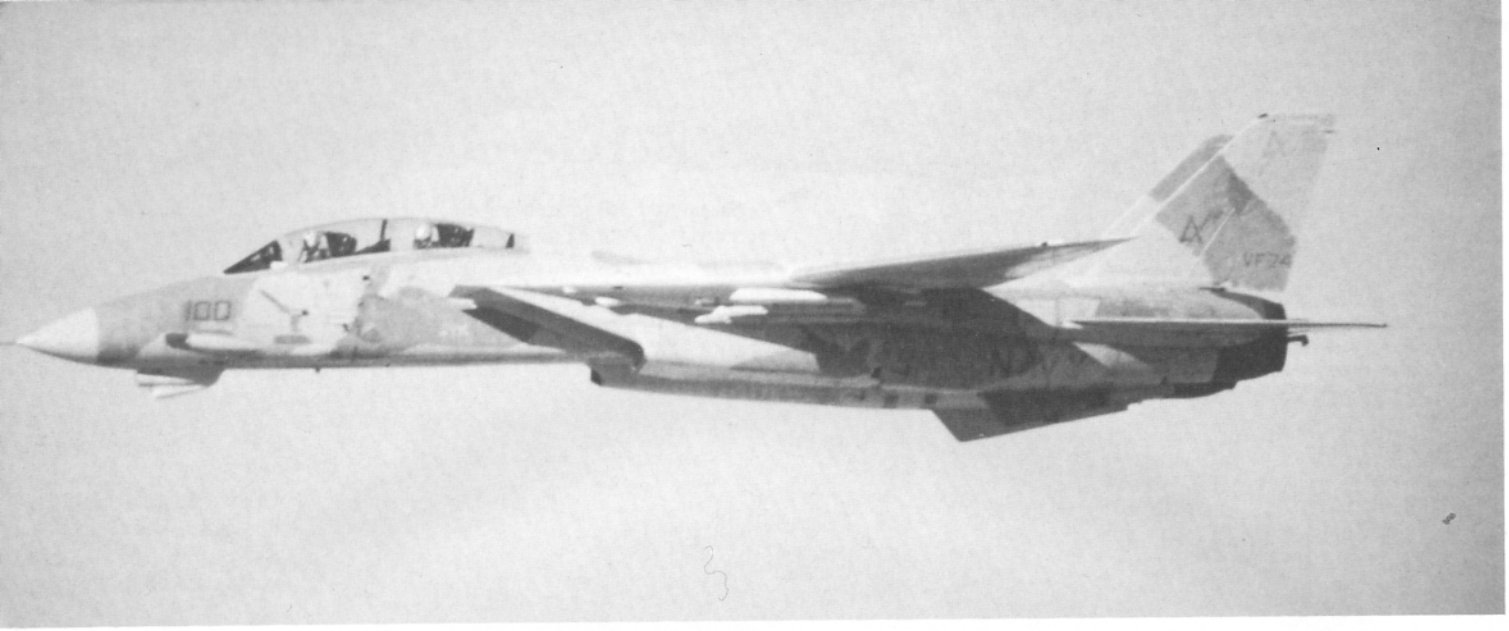
I found that it was very straightforward. The aircraft is exceedingly impressive, because when you are sitting there in a spin and put in recovery controls, you can immediately feel their effect and the aircraft recovers very honestly and very gently. The aircraft has both an upright and an inverted spin mode. The inverted spin is very very difficult to get into and the aircraft recovers from it very quickly.

The problem spin is the upright spin. If the yaw rate is allowed to continue to build, the spin will flatten out. When this happens, the rotation or yaw rate increases. In the cockpit, as this happens, you begin to get debilitating centrifugal forces pushing you forward towards the instrument panel. This is called "eyeballs out G." This occurs at something in excess of 100 degrees per second of yaw. That's the mode that you want to avoid. The F-14 retains very effective recovery controls, which is a double edged sword. If the pilot puts in recovery control input, the aircraft will recover very quickly, but if he doesn't, those same effective controls will drive it ever deeper into the high energy, flat spin."

Considering the importance placed on DLC by the other test pilots I had spoken to, I wondered if it had ever achieved general use in fleet squadrons.

"Way back when Direct Lift Control was first incorporated in the aircraft, there were two systems available, one with high control authority, and one with a much lower authority. By that, I mean that the response you got when you rolled in commands with the thumb wheel varied according to which system was installed. The Navy directed that we put in the system with the

VF-154 Black Knights also retained their F-4 style markings after transitioning to the Tomcat. In spite of the requirement for Tactical Gray camouflage, they painted Black/Red/Black tail stripes and full color national insignia on their Tomcats during 1988. (Ted Carlson)



During Reconnaissance Air Meet (RAM) 86, held at Bergstrom AFB, Texas during November of 1986, Navy Tomcats were camouflaged in experimental water-based paint schemes. This VF-74 TARPS Tomcat carries a mottled Green camouflage over its standard tactical Gray scheme.

lower authority. I thought that was a bad decision, but the Navy figured that if they gave a guy too much authority, he could get into trouble. In reality, higher authority only dictates correct use of the system.

The DLC that went into the fleet did not have enough authority, particularly in the nose up direction, to compensate for the deviations the guys were having on the glide scope. These are deviations that are caused by natural occurrences, such as the turbulence coming off the back end of the ship as it moves through the air. The tendency of all aircraft is to sink in the turbulence. The DLC authority was insufficient to get the aircraft back on the glide scope.

There are four sets of spoilers on the aircraft, two each side, inboard and outboard. The original DLC used all the spoilers on the aircraft. Well into the program some other test programs revealed that the outboard spoilers were hurting us more than helping. We tested a modification to DLC that would use the inboard spoilers only and use them at a higher deflection. This doubled the original authority of the DLC. Grumman was very impressed with this and we got the Navy up here to look at it, and they were very impressed. Unfortunately, there was no money in the budget to incorporate this change into fleet aircraft. The aircraft that are going to the fleet today with F-110 engines, which is an interim configuration until the F-14D is produced, all have this new DLC installed. The comments we are getting from fleet pilots are universally very positive. What this allows the pilot to do, is to fly the ball onto the mirror, then fly the rest of the approach using DLC.

Conceptually, what DLC does is to take the longitudinal characteristics of the aircraft out of the loop. What this means to the pilot is that he doesn't have to change the nose attitude of the aircraft to make a glide scope correction. All he does is dump a little lift off the wing, or recover some lift. So the aircraft is just controlled in the vertical axis, not the longitudinal axis."

I noted that most of the other test pilots I had spoken to had given Kurt credit for developing the Approach Power Compensator (APC) and I asked him to elaborate on its development.

"The original APC in the aircraft did not perform very well. I had the benefit of a lot of experience with those kinds of systems during my tour at NATC, developing APCs for the F-8 and the F-4. Using that experience, we modified the APC in the F-14. There are always some constraints when you are designing an APC. One of the limiting factors to responsiveness is how responsive the engine is and the TF-30 placed very real limitations on what we were able to accomplish. We worked within those parameters and I think we came up with a system that does as well as you can do with that configuration. I'm sure you are aware that pilots are very opinionated and APC brings out the diversity of opinion like nothing else will. Some people don't believe in APC, period. Other people consider it one of the most critical systems in the aircraft. One of the concerns people have about APC is: "If I use it on every pass and get dependent upon it, now I have an Achilles Heel; because what happens when it quits on a real dark night on final?"

VF-74 and VF-103 were the first Tomcat squadrons to re-equip with the F-14A Plus. The F-14A Plus is equipped with more powerful General Electric engines and updated avionics. (D.F. Brown)

The main external difference between the F-14A Plus and older F-14A Tomcats is the afterburner exhaust vanes and the exhaust geometry. This F-14A Plus is assigned to VF-74 at NAS Oceana, Virginia, on 31 March 1989. (D.F. Brown)

One of the most recognized Tomcat squadrons is VF-84 Jolly Rogers. This F-14A (BuNo 160406) of VF-84 taxies to the waist catapult aboard USS NIMITZ on 17 August 1982. (D.F. Brown)

Since Kurt had been with the F-14 almost from the very beginning, I wondered what kind of an improvement the new engines were making in the aircraft.

"Our afterburner thrust goes from 20,000 pounds per side up to 28,000 pounds per side. Dry power goes from 11,000 pounds per side up to 16,000 pounds per side, so the percentages are very high. All the compatibility and operability problems that we had with the TF-30 are gone with the F-110. The TF-30 engine's highest stall margin, which means the difference between its operating line and where the engine will stall, occurs when it is stabilized at military power. If you would like to go to idle power when you are maneuvering, you stand a very good chance of stalling the engine. The F-110 has tremendous stall margin everywhere and, at idle power, it's higher than anywhere else. When you are maneuvering with the F-110 engines, you can do whatever you want to do, whenever you want to do it.

About seventy current F-14As will be modified to the F-14A-Plus configuration with F-110 engines, the new DLC, and a modified Radar Homing And Warning (RHAW) receiver. These will be followed by the F-14D, which features a new avionics and radar suite as well as 110 engines."

I pled journalistic license for the next question, asking if it was safe to assume that had Maverick and Goose been flying a 110 powered aircraft, they would not have had to eject? That brought a chuckle and this answer:

"Absolutely. Now, you have to understand that whoever writes the script for a movie like that starts with the premise that they want to kill this guy. So what plausible event can they script to get the job done? The event that they scripted was, in fact, a very serious concern early in the F-14 program. When the aircraft is in a fully-developed flat spin, it is going at a very high yaw rate and it is spinning down in a very small radius.

In the ejection sequence, the canopy leaves first, then the back seat, then the front seat. If the aircraft is sitting on the ground and you blow the canopy, it will land between the vertical tails...and that has happened. If you have any forward vector at all, the canopy is out of the way before the seats leave the aircraft. The concern in a spin is that the canopy will be ejected straight up, followed shortly by the seats and the possibility exists for a collision. We have had several ejections in spins and I believe there was one case where the RIO brushed the canopy. So the scene was entirely possible.

Now, the way he got into the spin was much more fantastic. They postulated that he crossed the wake of another aircraft, which disturbed the airflow enough to cause an engine stall, causing asymmetrical thrust, which made the aircraft immediately spin. In reality, wake turbulence in itself would not cause the aircraft to depart or spin. But, that was Hollywood.

Now, with the 110 engine, there is some concern because of the greatly increased thrust which, if applied asymmetrically, could generate a stall/spin. We deal with that easily in 110 powered aircraft. If the aircraft departs for any reason, we just pull the throttles back to idle, which just takes all the thrust effects out of the equation and you recover the aircraft. Since the 110 loves to run at idle, there is no problem. Unfortunately, the TF-30 does not love to run at idle and you can't apply this solution."

LCDR Rick Hauck and LT Karl Volland get the launch signal from the catapult officer aboard USS FORRESTAL on 26 November 1973. (U.S. Navy)

A catapult crewman signals the pilot of this VF-84 Tomcat that the aircraft is ready to launch. The pilot checks longitudinal trim positions prior to advancing the throttles to mil power and the RIO has already placed his head against the headrest in anticipation of the catapult shot. (U.S. Navy)

An F-14 of VF-84 in the new three-tone tactical Gray camouflage. The aircraft is armed with Sparrow and Sidewinder missiles for a CAP mission off USS NIMITZ on 15 August 1986. (U.S. Navy)

A pair of VF-84 Tomcats (AJ-221 BuNo 161138 and AJ-223 BuNo 161141)on patrol off the USS NIMITZ while operating in the Guantanamo Bay Operating Area on 6 March 1981. VF-84 transitioned to the Tomcat during 1976, becoming fully operational during April of 1977 at NAS Oceana. (Robert L. Lawson Tailhook Photo Service)

Since the improvements in engine power and avionics seem to fit so well into the F-14 airframe, I asked Kurt if he felt it was necessary to build a next generation Navy fighter anytime soon.

"It is a real credit to the original design of the aircraft that the airframe has growth potential. The original intent of the program was that the TF-30 was only meant to get the prototypes flying, then the Pratt & Whitney 401 engines were going to be fitted to production aircraft. The 401 had all sorts of developmental problems and the Navy eventually cancelled the program. The total potential of the F-14 was never realized by the TF-30. With the 110 engines in the aircraft, the maneuverability is so enhanced that I am sure that the F-14A-Plus and F-14D are going to dominate the ACM arena.

This is all the more impressive when you consider the radar capability, the range, and the load-carrying ability of the F-14...all things which normally dictate compromises in agility. The next question is: "What is the growth potential now?" The answer is that there is tremendous potential. The airframe has a lot of volume, which means it is capable of receiving more of the new technologies, which are compact by nature. The maneuverability and range/payload characteristics are compatible with the future mission requirements. There is a condition called "Super Cruise," which is the ability to sustain supersonic flight without the use of afterburner. The aircraft comes very close to that with the 110 engines and there is growth potential in the 110 engines that could result in super cruise for a future F-14 variant.

The flight control surfaces in the F-14 are very powerful and, with the benefit of a new flight control computer system, the handling qualities of the aircraft could be significantly enhanced. The F-14 was designed to carry bombs. The Navy, however, chose not to develop that capability. There is now more and more emphasis on carrier deck loading and development of multi-mission aircraft, with the F/A-18 as the primary example of that. The F-14 is very capable of performing the air-to-ground mission, mainly because of our range and the fact that we carry the weapons conformally on the fuselage between the engine nacelles, which results in much less of a drag penalty than carrying bombs on the wings. The technology to enhance the radar for this mission has already been developed in the form of the F-15E. I think everyone realizes what the cost of developing a new aircraft is and, considering the capabilities resident in the F-14, it just makes more sense to keep on developing what we have.

An advanced Tomcat would have 90% of the capabilities of the projected Advanced Tactical Fighter (ATF) at a substantially lower price. There has never been a successful adaptation of an Air Force aircraft to the Navy mission, although there have been several cases of the Air Force adapting Navy aircraft for their missions. They are fighting a weight problem with the ATF and, although the Air Force certainly doesn't want to accept overweight aircraft, their constraints are not the same as those imposed on carrier-based aircraft. So, while the ATF may be acceptable to the Air Force at a given weight, it will possibly be too heavy for the Navy. The program has the potential to become another F-111B.

A Jolly Roger F-14 fires an AIM-54 Phoenix during a live fire exercise. The AIM-54 is the largest, most expensive and most sophisticated air-to-air missile in the world. It holds all records for accuracy and range and the F-14 can carry up to six AIM-54s, which can be launched at six targets simultaneously. (Grumman)

A pair of VF-101 Grim Reapers Tomcats over the Atlantic. The squadron is the East Coast F-14 RAG, a task assigned to the Oceana, Virginia based squadron since 1975. (Robert L. Lawson Tailhook Photo Service)

This VF-101 Tomcat (BuNo 161855) carried special markings for the 75th Anniversary of Naval Aviation. The aircraft was on the NAS Oceana ramp on 19 April 1986. (D.F. Brown)

The F-14 today is the best interceptor the Navy has ever had by a heavy margin. When I flew the F-8 and F-4 operationally, we would run fleet intercept missions and feel good if we intercepted half of the bogies attacking the fleet. Today, the F-14/E-2 team routinely intercept 100% of the incoming bogies. There is not another aircraft in the inventory that comes close to that."

I asked Kurt for one last flying story about the F-14. This is the story that came to mind;

"Developing an aircraft such as the F-14 involves long hours of dedication by a multitude of very talented people. During any flight test program, there will be successes and failures, triumphs and frustration, and far too often, tragedies. Grumman's F-14 Project Pilot, Bill Miller, was a man of extraordinary talent whose contributions to the F-14 program played a significant role in the success of the aircraft. Bill was involved in the initial attempts to reach the design maximum Mach number of 2.4. Inlet performance is very critical at those speeds and the variable inlet ramp schedule had not yet been optimized. Consequently, the aircraft would reach 2.1 Mach number and then stagnate.

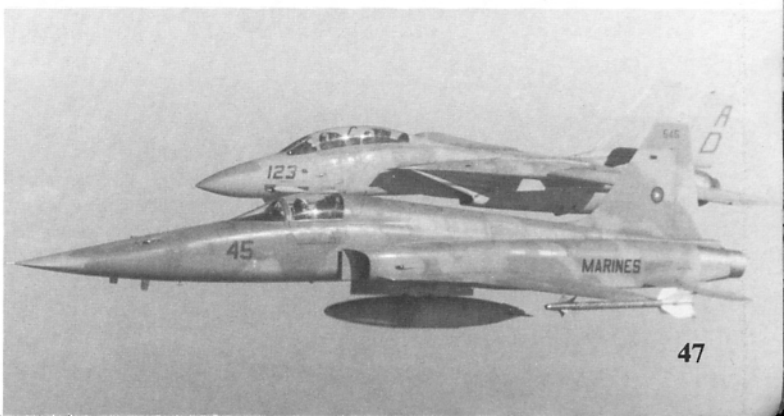
Several attempts were made without success which resulted in a high level of frustration at the debrief session. While discussing potential reasons why the aircraft wouldn't go faster, a well-meaning engineer in the back of the room raised his hand and asked Bill, "Are you sure the throttles were all the way forward?" This is similar to asking a friend concerned about poor gas mileage whether he drove with the hood up or down. Under the circumstances, Bill controlled his temper well and waited until the following day.

When the aircraft once again refused to accelerate past 2.1 Mach number, Bill calmly began to recite his "High Mach Checklist" over the radio, to the delight of everyone, except possibly that engineer. He facetiously called out: "throttles -full forward, landing gear-retracted, flaps - retracted, speed brake -in, canopy - closed." It was a major loss to everyone when this talented man lost his life in the cockpit of F-14A #10 at Patuxent River (in an accident unrelated to flight testing). For the record, with the benefit of an optimized inlet ramp schedule, Joe Burke and Roger Ferguson later took F-14A #1X to a level flight Mach number of 2.41."

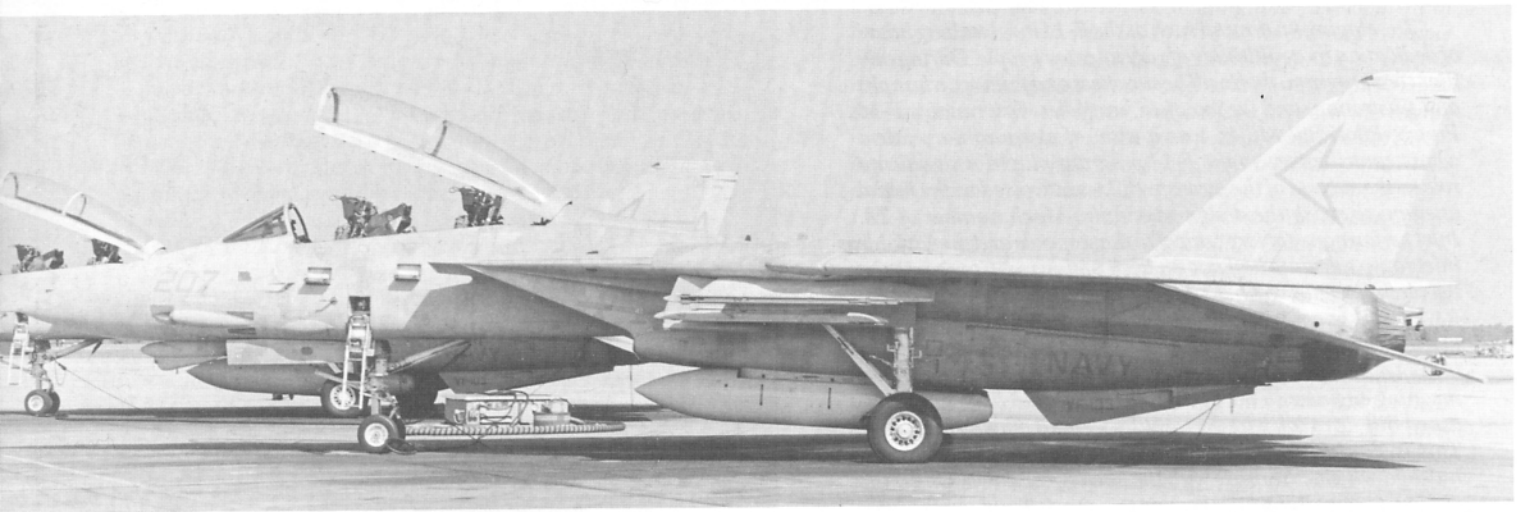
(Above) This Jolly Rogers F-14A has just fired a medium range AIM-7 Sparrow at a drone target. The AIM-7 is the latest variant of the Sparrow and uses solid-state electronics and a solid rocket motor. The AIM-7 will be replaced by the state-of-the-art AIM-120 AMRAAM. (Grumman)

(Below Left) When the Commanding Officer's call sign is Moon, his aircraft may carry some fairly unusual markings. The moon on the fin was in Dark Gray. The Tomcat is parked on the NAS Oceana ramp on 31 April 1983. (D.F. Brown)

An F-14A of VF-101 form on the wing of an F-5E of VF-43 Aggressors after completing an Air Combat Maneuvering mission out of NAS Key West, Florida, on 3 November 1984. (U.S. Navy)

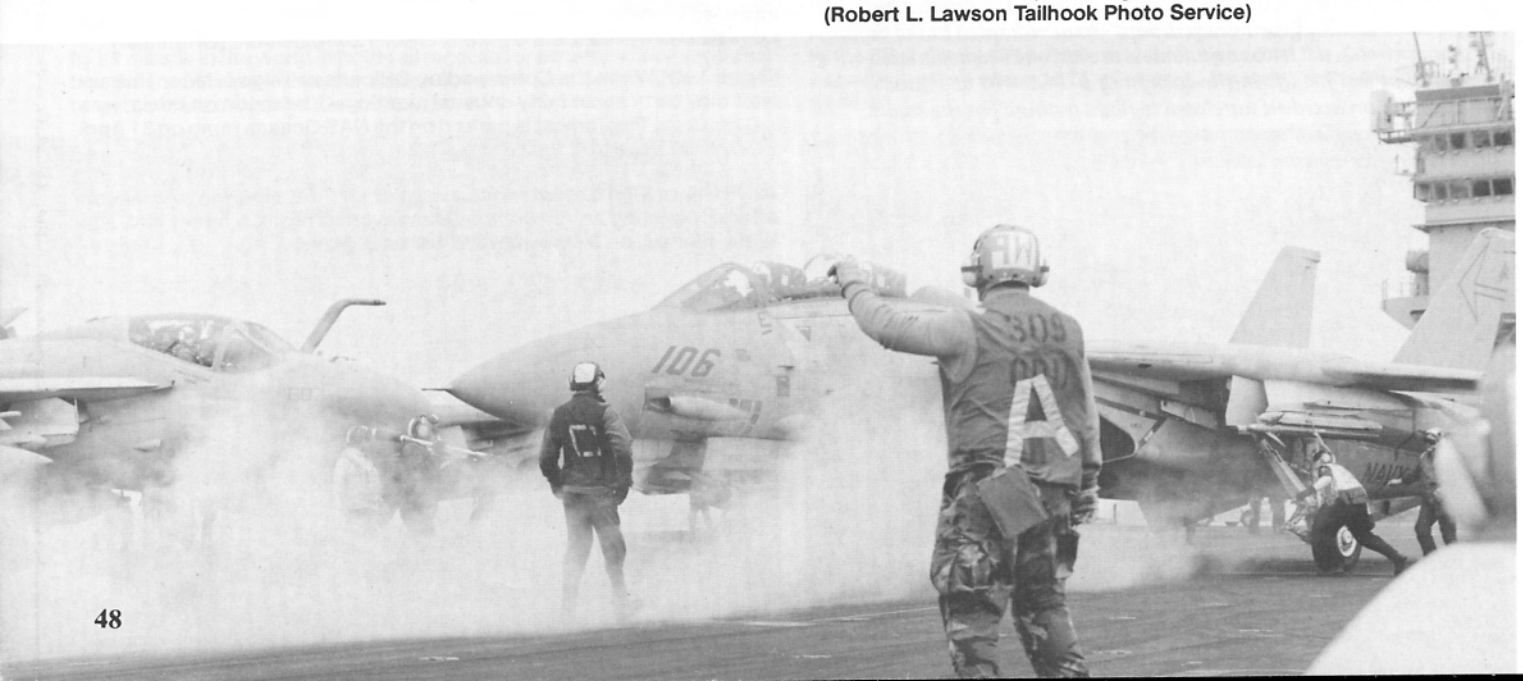


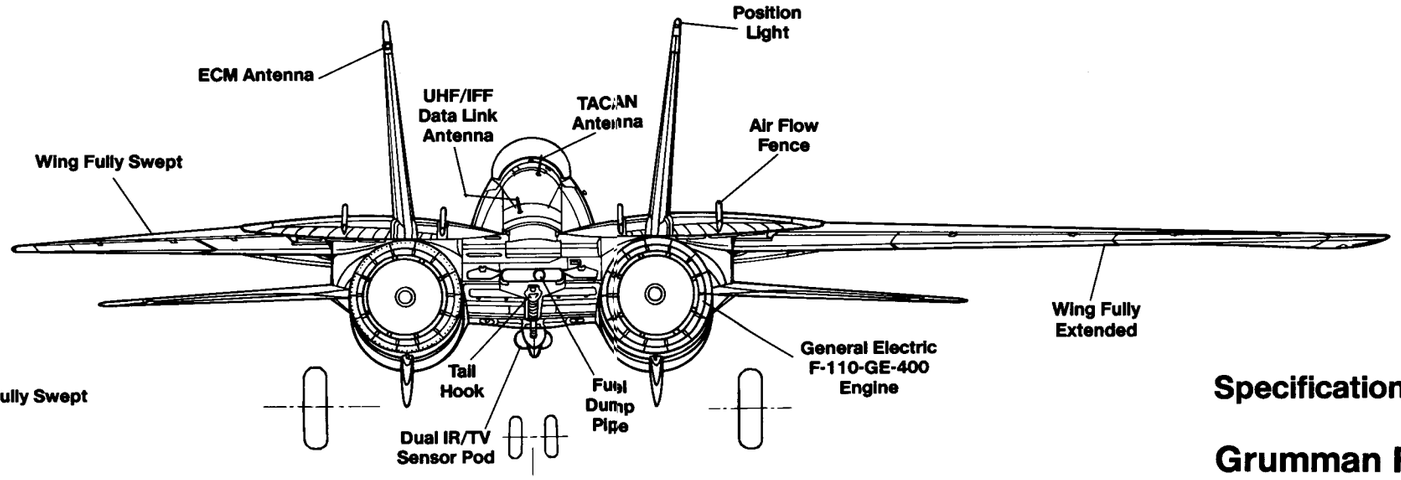
An F-14 of VF-301 Sluggers, bolters (tailhook missed all wires) aboard USS ENTERPRISE. The Tomcat flight manual contains the following "Caution": *The use of excessive back stick on a bolter may cause the tail surface to stall, delaying aircraft rotation and causing the aircraft to settle off the angle.* (Robert L. Lawson Tailhook Photo Service)

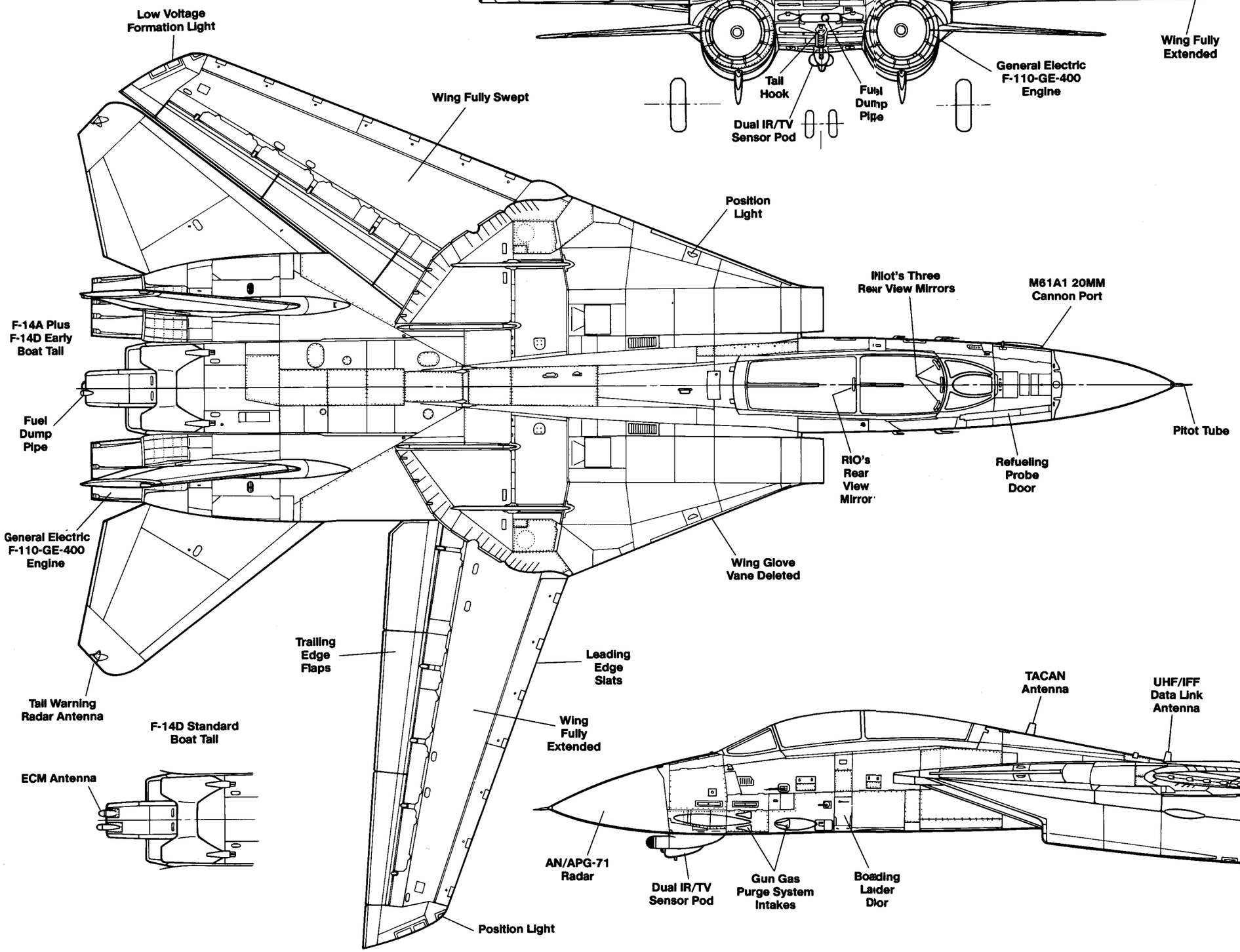


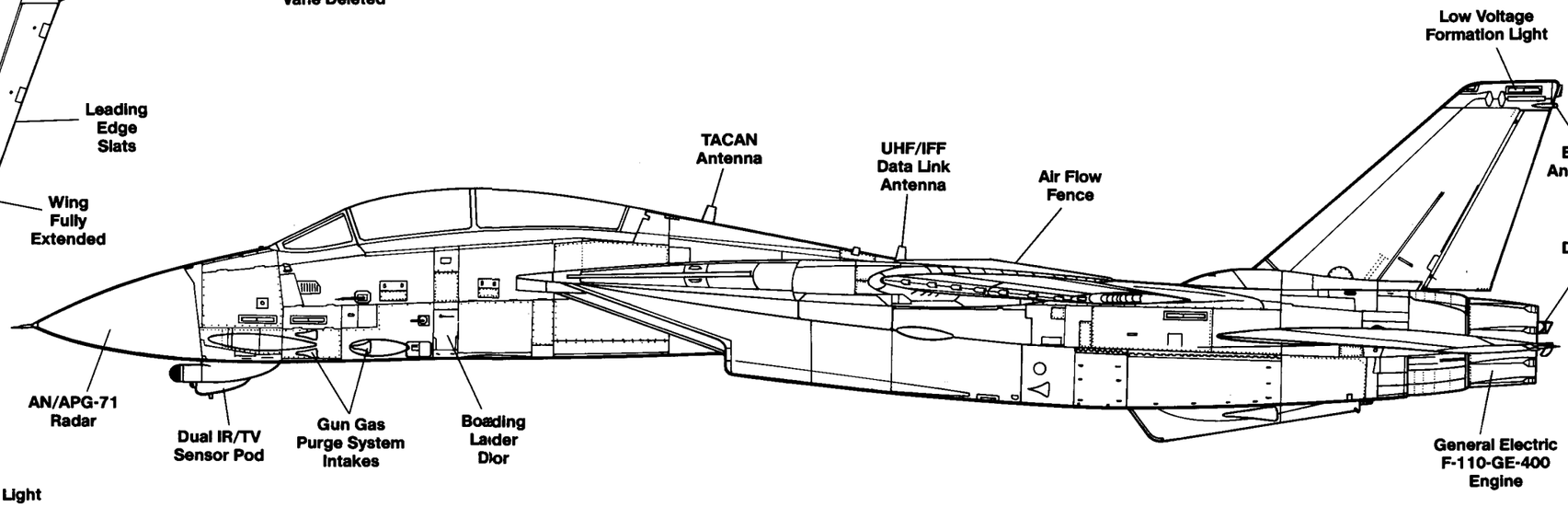
(Above) This drop tank equipped F-14A (BuNo 160912) of VF-103 was tied down and chocked on the ramp at NAS Oceana, on 13 September 1986. The Sluggers transitioned to the Tomcat during 1983. (D.F. Brown)

(Below) Deck crews move a Tomcat onto the catapult aboard USS ENTERPRISE. Director hand signals above the waist are for the pilot; signals given below the waist are for the deck crew. The F-14's full nose wheel steering deflection (70 degrees) allows the inside main mount wheel to back down, allowing the Tomcat to make very tight turns. (Robert L. Lawson Tailhook Photo Service)









Specifications

Grumman F-14D Super Tomcat

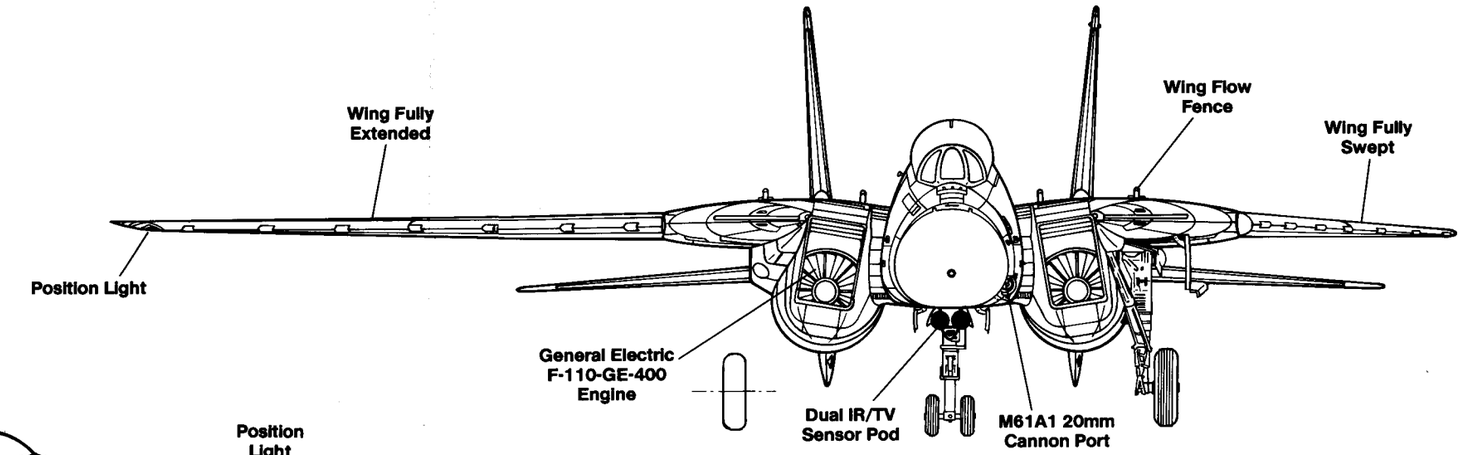
Wingspan ..... 64 feet 1½ inches
Length ..... 62 feet 8 inches
Height ..... 16 feet
Empty Weight ..... 41,780 pounds
Maximum Weight ..... 74,349 pounds
Powerplant ..... Two General ELectric 27,000 lbst F-110-GE-400 turbofan engines.

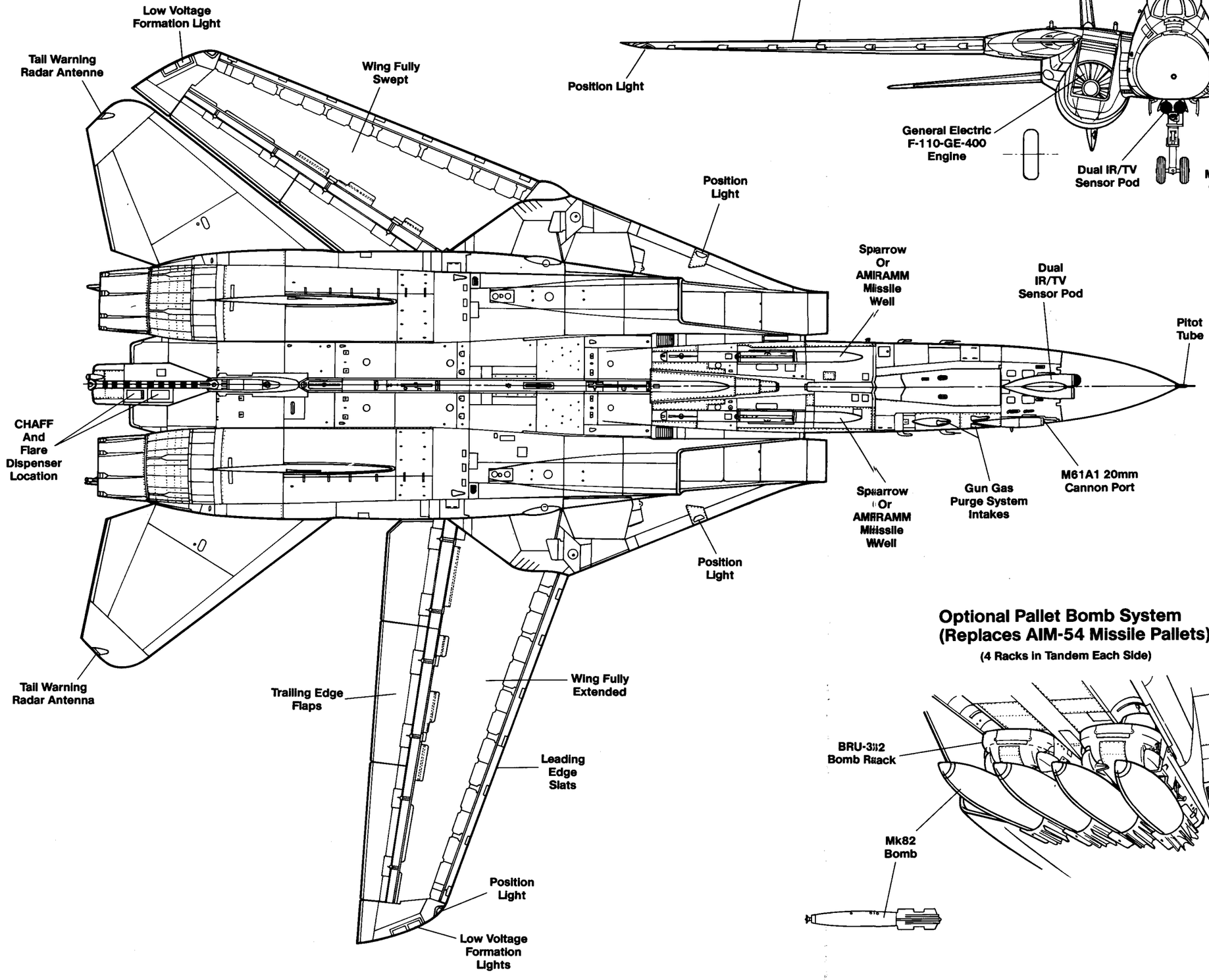
Armament ..... One M-61A-1 20MM cannon (internal), six AIM-54C Phoenix or six AIM-7 Sparrow or six AIM-120 AMRAAM and two AIM-9 Sidewinder missiles. Provision for AGM-65 HARM anti-radiation missiles and various air-to-ground weapons

Performance
Maximum Speed ..... 1,544 mph
Service ceiling ..... 53,000 feet
Range ..... 2,000 miles (with tanks)
Crew ..... Two

M
Ft

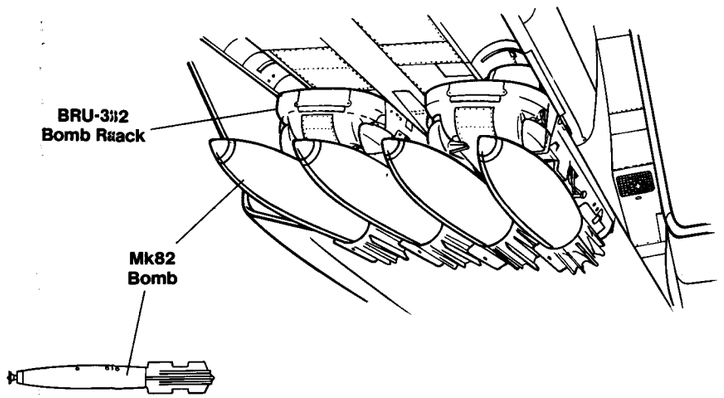
Scale 1" = 6'



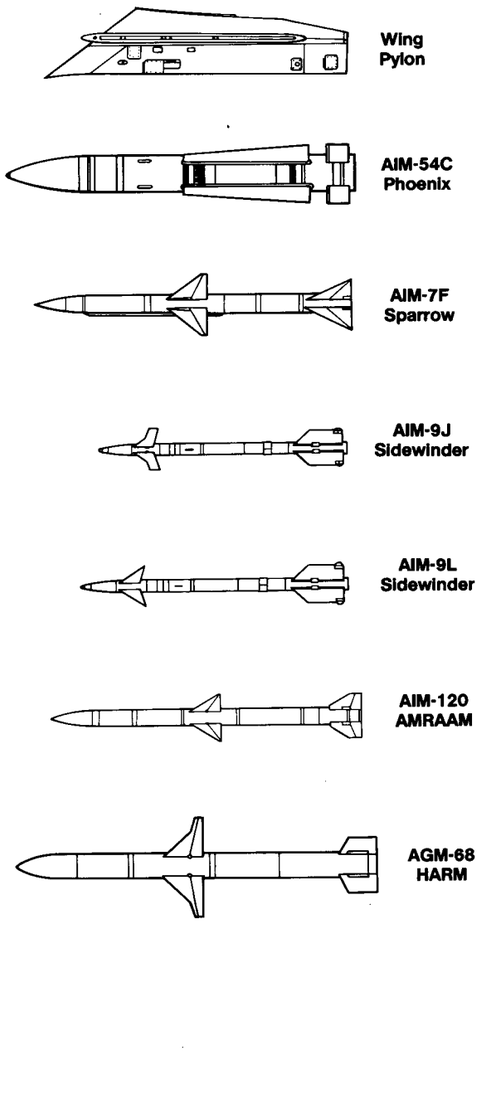


Optional Pallet Bomb System (Replaces AIM-54 Missile Pallets)

(4 Racks in Tandem Each Side)

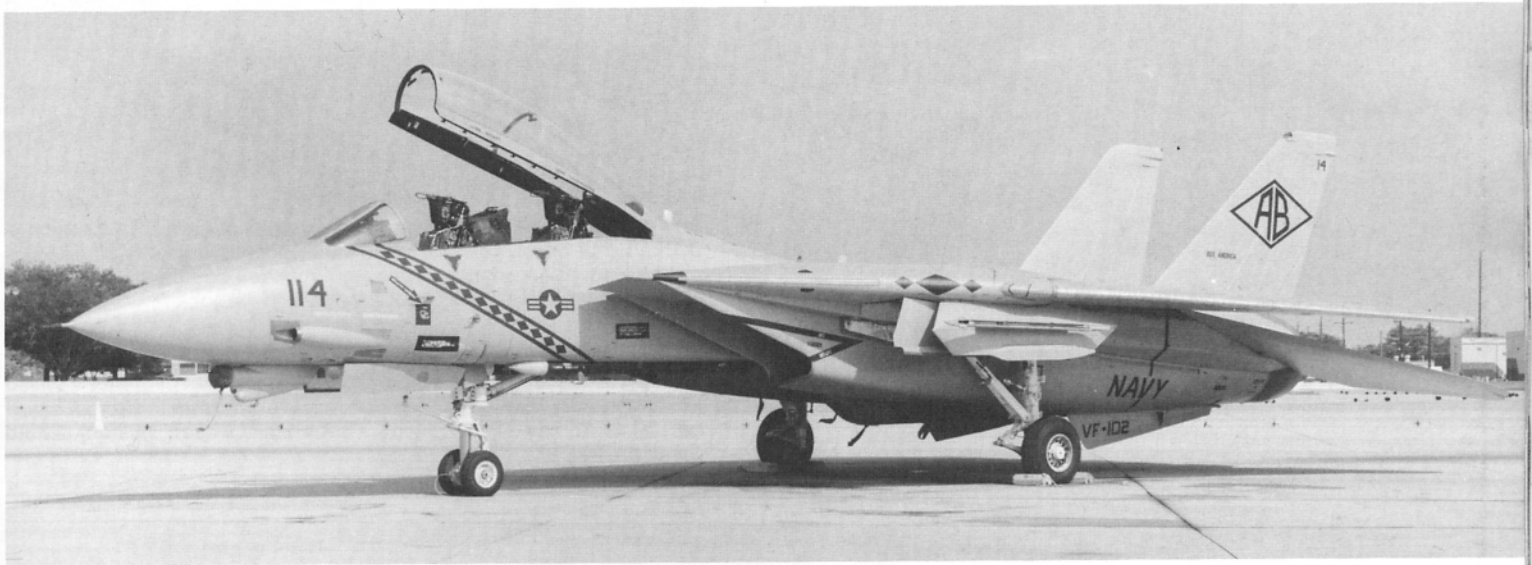


WING MOUNTED ARMAMENT



(Above) VF-102 transitioned to the Tomcat during 1982 and was assigned to Carrier Air Wing One (CVW-1) aboard USS AMERICA (CV-66). (U.S. Navy by Robert L. Lawson)

(Below) AB 114 is an F-14A assigned to VF-102 Diamond Backs. The TARPS equipped Tomcat (BuNo 161135) was taking part in RAM 86, held at Bergstrom AFB, Texas, on 2 November 1986. (George Cockle via D.F. Brown)



An F-14 of VF-111 Sundowners is positioned on the starboard catapult aboard USS CARL VINSON. The Tomcat is in a 2-3 degrees nose-down attitude, under tension from the catapult shuttle. Release from the shuttle at the end of the cat shot results in a short-term vertical acceleration of 15 to 20 Gs. (Robert L. Lawson Tailhook Photo Service)

An F-14 Tomcat of VF-111 Sundowners lands aboard USS CARL VINSON. VF-111 began its transition to the Tomcat during 1977. The squadron has carried the sharkmouth on its aircraft since it flew the Grumman F11F-1 Tiger during 1959. (Robert L. Lawson Tailhook Photo Service)

An F-14 of VF-111 takes a wave-off and crosses the ramp of USS CARL VINSON as the entire LSO platform looks on. Tomcat pilots are advised not to use more than military power on wave-offs, due to slow afterburner lights on the TF-30 engine. (Robert L. Lawson Tailhook Photo Service)

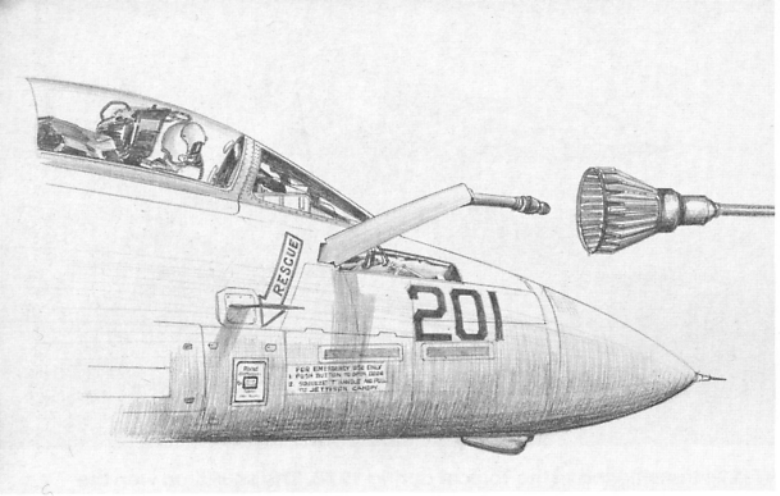
Deck crewmen remove snow and ice from a VF-111 Tomcat prior to a 21 January 1987 mission from USS CARL VINSON. The VF-111 CAG Tomcat next to it carries USS KITTY HAWK tail markings from a prior air group assignment. (U.S. Navy)

VF-114 transitioned to the Tomcat during 1976. The squadron won the ComFitAEWWingPac gun derby, known as High Noon, held at NAF El Centro in both 1982 and 1983. This flight was led by LT Kevin Sullivan and LTJG John Martin in NH-110, with LCDR Buddy Weber and LCDR Geoff Carey in NH-114. (Robert L. Lawson Tailhook Photo Service)

NH 100, an F-14A (BuNo 161298) of VF-114 Aardvarks, is the squadron's CAG Tomcat. The aircraft was landing at NAS Miramar on 19 January 1989. The aircraft is painted in the current Tactical Gray camouflage. (Ted Carlson)

This F-14A (BuNo 159862) of VF-114 at NAS Miramar on 5 April 1984 carries the squadron's full color markings. The aircraft was being prepared for the squadron's May to December WESTPAC cruise aboard USS ENTERPRISE. (Brian Rogers via D.F. Brown)

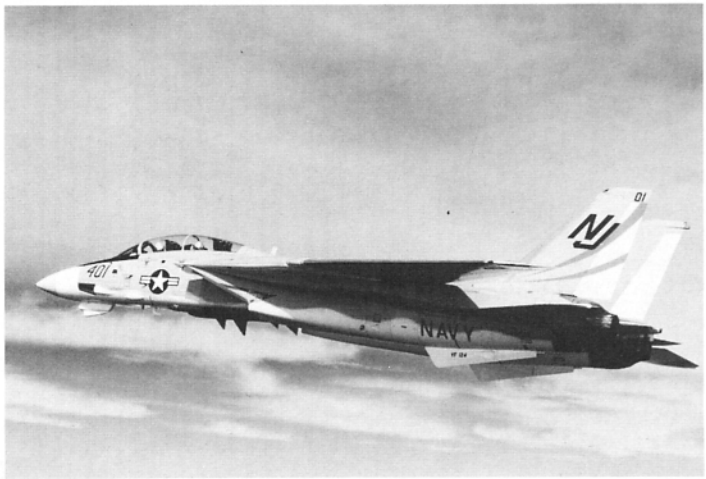
TARPS equipped Tomcats of VF-102 took part in RAM-86, a photo reconnaissance exercise. Participants in the Tactical Air Command hosted international reconnaissance meet included USAF, Air National Guard, U.S. Navy, USMC, RAAF, and RAF aircraft. (USAF)



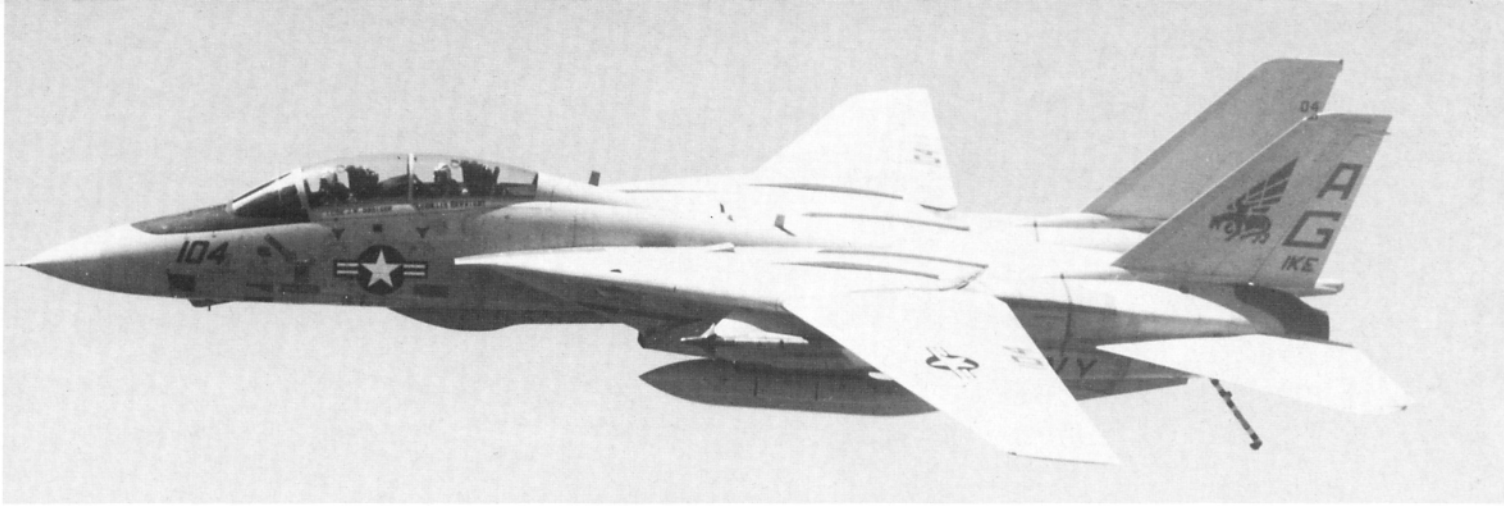
A plane director guides an F-14A of VF-124 onto the starboard catapult aboard USS CONSTELLATION during 1987. The nose tow bar can be lowered into the catapult shuttle by either the pilot or by the deck crew. (U.S. Navy)

VF-143 made their first Tomcat cruise aboard the carrier USS DWIGHT D. EISENHOWER during 1979. This Tomcat on the ramp at Oceana during August of 1988 carries full squadron markings. (D.F. Brown)

VF-124 has been the West Coast fighter RAG since 1958, when it was assigned to training new fleet F-8 Crusader pilots. It was chosen as the first F-14 training squadron during 1970 and began reorganization and training for this mission immediately. It did not, however, take delivery of its first Tomcat (NJ-401 BuNo 158617) until October of 1972. (Grumman)



This VF-143 Tomcat was armed with an unusual configuration of four AIM-9 Sidewinders on the wing pylons and three AIM-7 Sparrows on the fuselage for a combat air patrol mission during 1987. (U.S. Navy)



An F-14 of Pukin Dogs approaches the break over USS DWIGHT D. EISENHOWER during 1987. Normal carrier landing pattern starts with a level break at 800 feet, with 300 to 350 knots indicated air speed (KIAS). When established wings-level on downwind leg, the F-14 pilot will descend and fly the pattern at 600 feet MSL. (U.S. Navy)

A Tactical Gray camouflaged F-14A of VF-142 Ghostriders about to touchdown at NAS Oceana on 31 January 1989. The Ghostrider insignia on the fin is in Black. (D.F. Brown)

The hold back cable has been attached to this Tomcat, but the nose tow bar has not been dropped into the catapult shuttle. When the shuttle is returned, the pilot will lower the bar to engage it, tension will be placed on the hold-back and the Tomcat will be ready for launch. (U.S. Navy)

(Above)
An F-14 of VF-142 on the waist catapult aboard USS DWIGHT D. EISENHOWER. Although the blast deflector is raised, launch is not imminent, since the wings are still in the 75 degree oversweep position and there are tie-down chains in place on the landing gear. (U.S. Navy)

(Below) An Aviation Boatswain's Mate (fuels) hauls a fuel hose to an F-14 of VF-154 during cyclic operations aboard USS CARL VINSON on 20 April 1984. The purple shirts are in charge of all fueling operations on the flight deck. (U.S. Navy)

(Above) The plane captain signals the pilot of this VF-194 Hellfires Tomcat on the ramp at NAS Miramar on 27 February 1987 to start his port engine, while squadron mechanics check engine controls. The port engine bay is open for the mechanics to perform their checks and tests. (U.S. Navy)

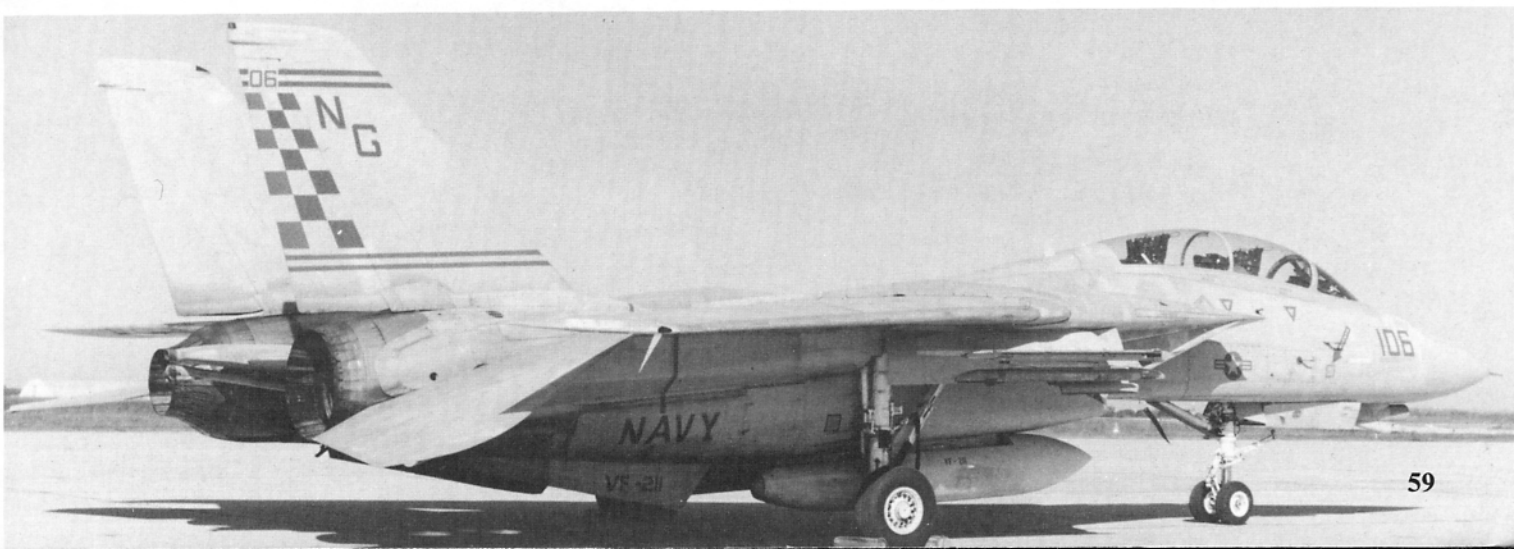
(Below) VF-201 is the sister squadron of VF-202 at NAS Dallas, Texas. The squadron marking consists of an outline of the State of Texas in Black, with the air group code, AF, carried inside it. (Grumman)

(Above) An F-14 of VF-211 Fighting Checkmates on short final at NAS Miramar, California during 1979. VF-211 transitioned to the Tomcat during 1975, one of the few squadrons to go from the single-seat, single-engine Crusader directly to the Tomcat. (Robert L. Lawson)

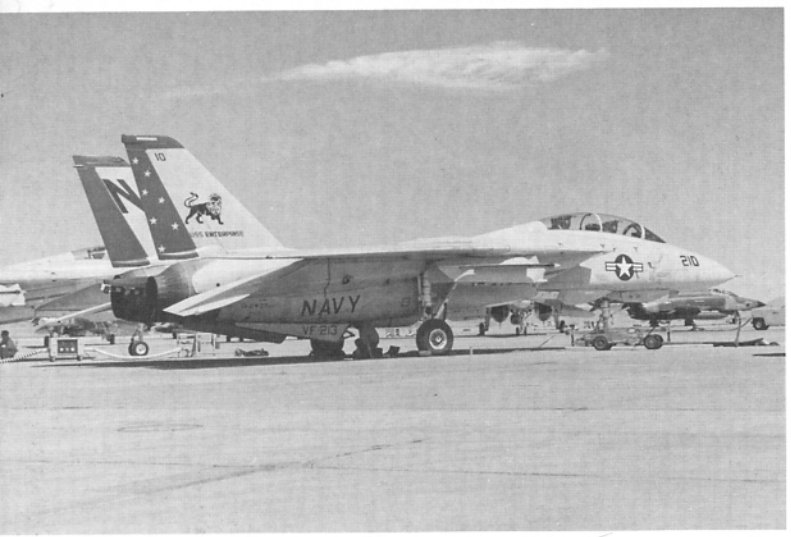
(Below) This VF-211 Tomcat is configured with two external fuel tanks during November of 1986. Each tank has a capacity of 534 gallons. The maneuvering devices, leading edge slats and trailing edge flaps are deployed. (U.S. Navy)

(Above) Then Vice President George Bush, addresses the ship's company on the hangar deck of USS RANGER (CV-61) during a 1983 visit to the ship. The Tomcat is the CAG aircraft of VF-211. (U.S. Navy)

(Below) An F-14 (BuNo 159631) of VF-211 tied down and chocked on the ramp at NAF Andrews, Washington, D.C., on 26 September 1987. The checks on the rudder are Dark Gray. (D.F. Brown)



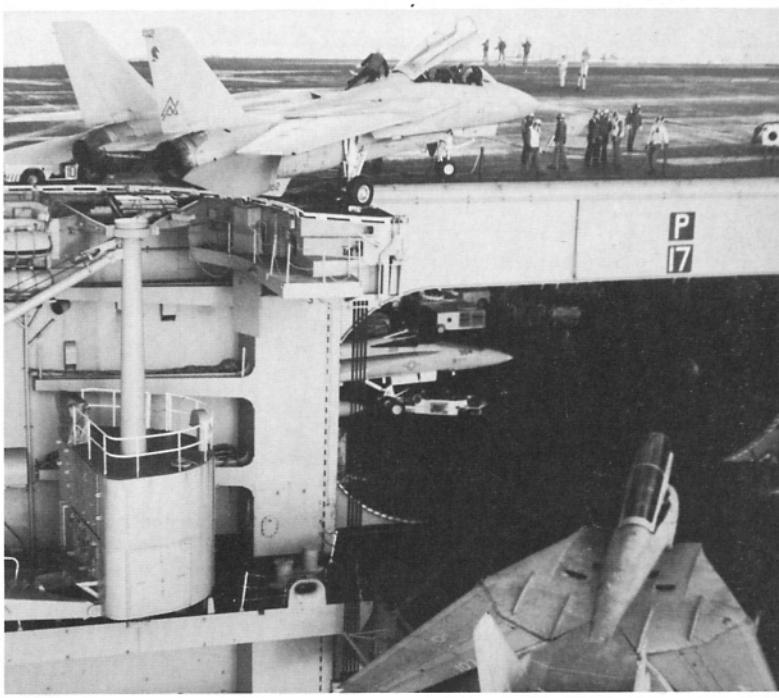
This F-14A of VF-213 Black Lions carries the squadron's F-14A full color markings consisting of Royal Blue rudders and fin cap with Gold stars and a twin tailed Black Lion. The aircraft was on the ramp at NAS Kingsville, Texas during December of 1976. (U.S. Navy)



When the Navy eliminated the Gloss White undersides on the Tomcat in favor of overall Dark Gull Gray, colorful markings were retained by some squadrons, such as this VF-213 TARPS Tomcat at NAS Fallon. (Don Linn)

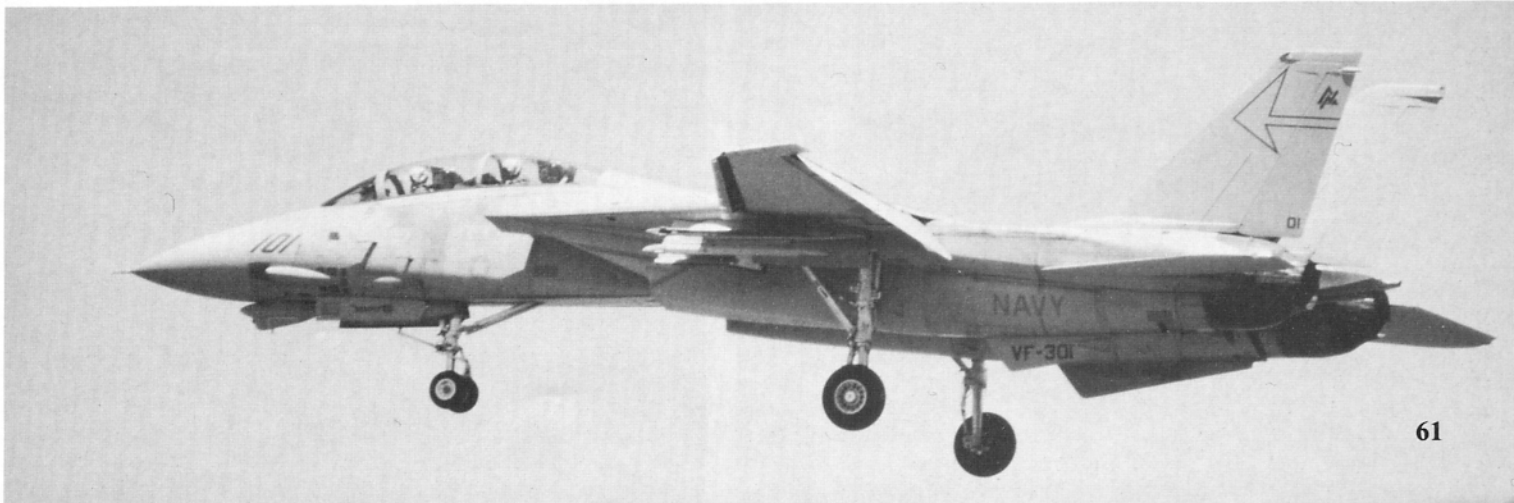
Later, VF-213 lost their Blue rudders, but retained the stars and the Black twin tailed Lion. The markings were labeled as "experimental" during November of 1980. (U.S. Navy by Robert L. Lawson)

This Tomcat of VF-302 Stallions is about to touch down aboard USS ENTERPRISE during carquals. VF-302 transitioned to the Tomcat during 1985. The squadron was initially equipped with fleet veteran F-14s. (Robert L. Lawson Tailhook Photo Service)



Space on the deck of a carrier is always at a premium. The F-14 of VF-302 on the flight deck cannot be moved until its squadron mate is brought up from the hangar deck on the deck edge elevator. (Robert L. Lawson Tailhook Photo Service)

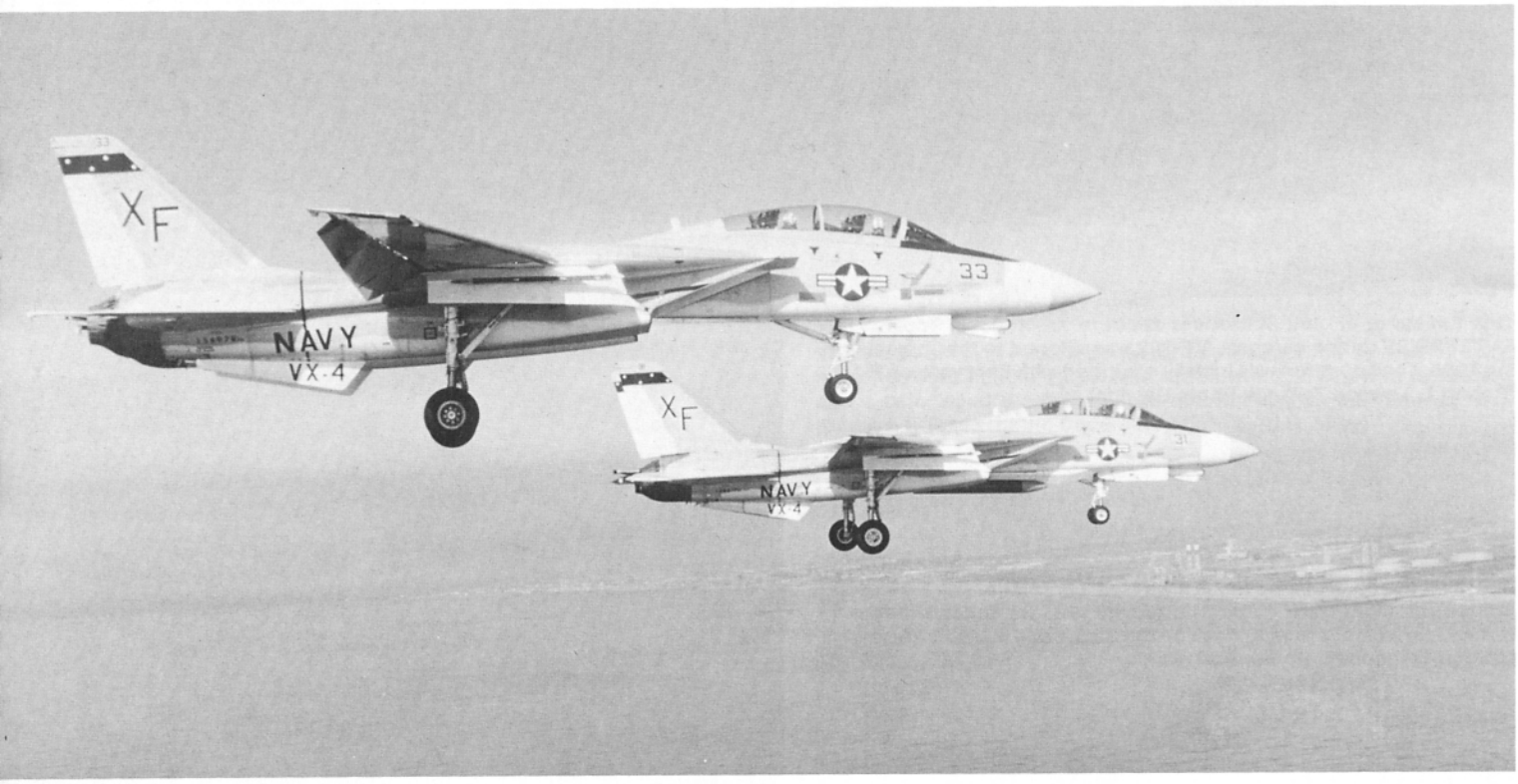
An VF-14 (BuNo 158990) of VF-301 Devil's Disciples lands at NAS Miramar on 11 May 1988. The Devil's Disciples were commissioned during 1970 and transitioned to the Tomcat during 1984, after having flown the F-8 and F-4. (Ted Carlson)



(Above) An F-14 of Naval Reserve Squadron Two Zero Two (VF-202) Superheats on final approach to MCAS El Toro, California on 4 March 1988. VF-202 was commissioned at NAS Dallas on 25 July 1970. It is one of four Navy Reserve F-14 squadrons. (Ted Carlson)

This F-14A (BuNo 158625) is assigned to the the Pacific Missile Test Center (PMTC). The aircraft was on final for landing at NAS Point Mugu, California on 23 October 1983. (Ted Carlson)

A pair of VX-4 Tomcats on final approach to Point Magu. VX-4 has operated the F-14 longer than any other squadron, receiving their first Tomcats during 1972. They continue their mission of evaluating improvements to the Tomcat's weapons systems. (Harry Gann Photo)



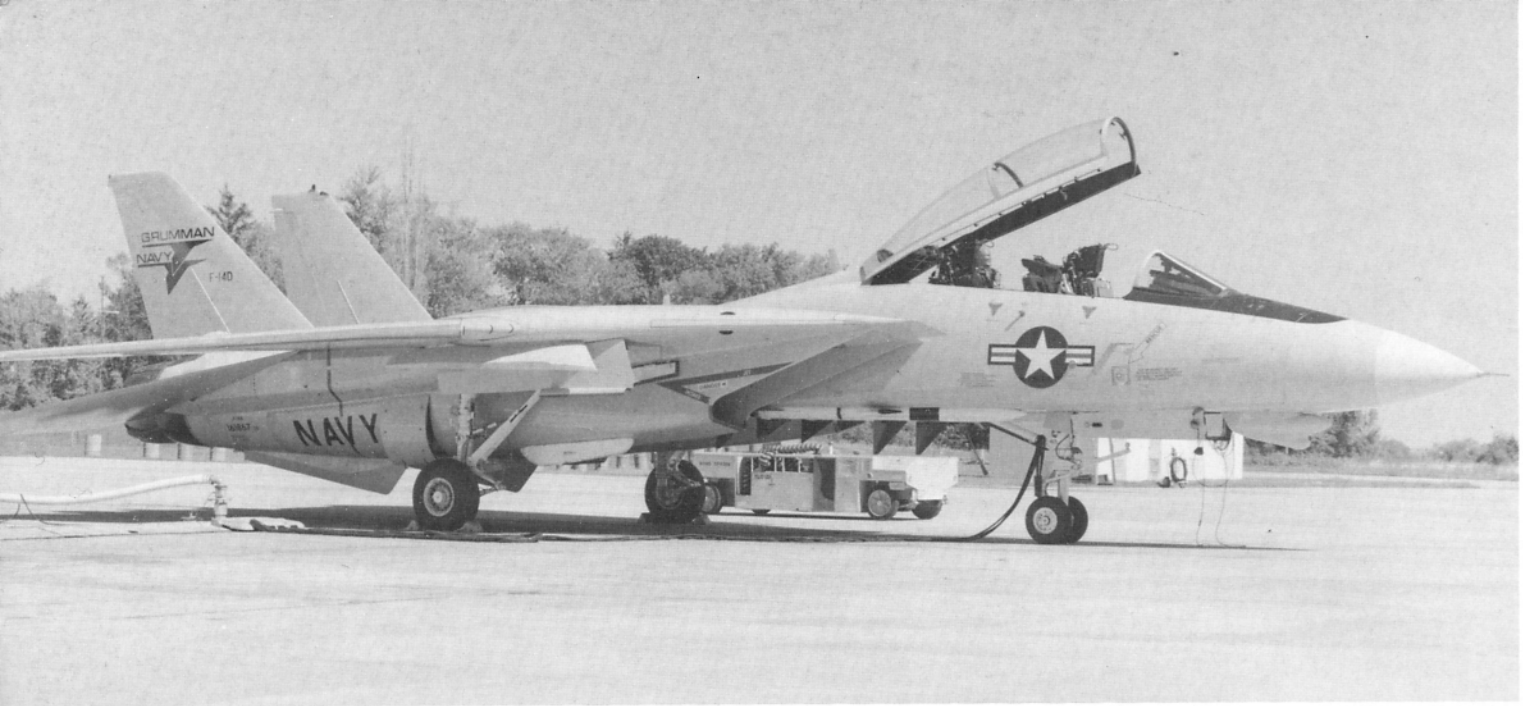
NL-105, an F-14 Tomcat (BuNo 160684) of VF-51 on final approach to Naval Air Station Miramar, California, on 11 May 1988. The wings are in the full forward position and the flaps are fully deployed. (Ted Carlson)

This VF-142 Tomcat is about to launch with the wings in the 20 degree sweep position and with the flaps fully extended. VF-142 transitioned to the F-14 during 1975, making their first Tomcat cruise aboard USS AMERICA during 1976. (U.S. Navy)

VF-143 Pukin' Dogs gave up their Phantoms in favor of the F-14 Tomcat during 1975. The squadron was one of the first two Atlantic fleet F-14 squadrons. This VF-143 Tomcat (BuNo 159430) was hooked to a tow vehicle on the ramp at NAS Oceana, during April of 1975. (Lionel Paul via D.F. Brown)

The pilot and NFO man an F-14 of VF-111 aboard USS KITTY HAWK during Exercise Fortress Gale on 22 August 1979. The KITTY HAWK is a Pacific based carrier usually operating as part of the 7th Fleet. (U.S. Navy)

This XV-4 Evaluator's Tomcat was used to evaluate an experimental splinter camouflage scheme during the AIMVAL/ACEVAL missile evaluations held at Nellis AFB during 1977. The scheme was not selected for operational use.



Although marked as an F-14D, this aircraft is actually an F-14A Plus (BuNo 161867) during testing at NATC Patuxent River on 5 October 1987. The F-14D is the definitive variant of the Tomcat, with more powerful engines and a state-of-the-art avionics suite. (D.F. Brown)

The number seven prototype F-14 was to have been the F-14B prototype. When the Navy did not build the F-14B, number seven went into storage. It was brought out of storage during 1982, fitted with General Electric F-101 Derivative Engine (DFE) engines for a three month test program. (Grumman)

Grumman propsed the 'TOMCAT 21' to the Navy as an alternative to a Navy Advanced Tactical Fighter (ATF). The Tomcat 21 would contain enhanced all-weather air-to-air/air-to-ground weapons systems, upgraded engines, a modified airframe, a leading edge maneuvering slat that works in concert with a new Fowler flap and other improvements. (Grumman)

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